ADOPTION OF THE
METRIC SYSTEM OF WEIGHTS AND MEASURES
ON
INDIAN RAILWAYS

REPORT
OF THE
RAILWAY METRIC COMMITTEE

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY TESTING AND RESEARCH CENTRE

ALAMBAGH, LUCKNOW.

Ref. No. RMC/4. March 23, 1957.

The Secretary,
Railway Board,
Ministry of Railways,
New Delhi.

Sub : **Appointment of an adhoc Committee to examine the question of changeover from the present system to the metric system.**

Ref : **Board's letter No. E55CO1/39/3, dated 20th August, 1955.**

The Report of the Railway Metric Committee on the implications of the adoption of the metric system of weights and measures on the Railways is herewith submitted.

2. The steps necessary for the implementation of the changeover on Railways, have been outlined in considerable detail in the Report. It is felt that in order to conform to the limit of the 10 year transitional period as laid down in the Standards of Weights and Measures Act, 1956, it would be essential to initiate immediate action on some of the important recommendations of the Committee. Since full consideration of the Report may take some time, it is suggested that Board's orders on the following recommendations may be issued at a very early date :—

(*a*) Recommendation No. 1.
A Metric Cell should be set up immediately under the Additional Member Mechanical of the Railway Board, to plan and direct the changeover to the metric system on Railways. The Cell should consist of one Joint Director from the Mechanical Engineering branch and one Deputy Director each from the Civil Engineering, Stores and Traffic (Transportation and Commercial) branches. (Chapter III, paras 3, 1, 1, 1 and 3, 1, 1, 3).

(*b*) Recommendation No. 6.
Railways should initiate early action in the matter of recalibration of weighing machines and weigh-bridges to show in addition the metric units of weights. (Chapter III, para 3, 2, 2, 3).

(*c*) Recommendation No. 11.
The Central Standards Office should immediately select suitable metric scales for use in Engineering Drawing Offices and issue a directive to all Railways on this subject. (Chapter IV, para 4, 2, 3, 1).

(*d*) Recommendation No. 16.

The Civil Engineering Department of Railways should work out the station-to-station distances in kilometres from the longitudinal sections, in advance of the actual fixation of kilometre posts and supply these particulars to the Commercial Department, not later than the end of 1957, to enable timely revision of fare and rate tables. (Chapter V, para 5, 3).

(*e*) Recommendation No. 18.

Railways should be advised immediately to commence marking of tare weight, carrying capacity, floor area on the existing and the metric units on all goods stock during periodical overhaul. (Chapter VI, para 6, 6 'a').

3. The estimates of requirements of additional draftsmen for the Central Standards Office and for the other engineering branches of Railways, have been indicated in the relevant chapters. The Railways are already facing considerable difficulty in the timely recruitment of draftsmen against their normal vacancies. It is, therefore, suggested that the Board may authorise the Railways to proceed immediately with the recruitment of about 50% of the number of draftsmen recommended in our Report so that the revision of designs and drawings could be commenced early.

(Sd.) (S. L. Kumar)
Director Research & Chairman,
Railway Metric Committee.

H. M.

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CHAPTER I

INTRODUCTORY

1. 1 General

1. 1. 1 The desirability of introduction of the metric system of weights and measures in the country has been considered more than once during the last 100 years. As early as 1867, this matter came under examintion and the Government of India passed an Act (Act XXXI of 1871) equating the seer to the kilogram and adopting other metric weights and measures. This Act, however, due to various reasons, remained a dead letter.

1. 1. 2 Though the proposal to introduce the metric system in India was again mooted from time to time, it was only after the end of world war II that serious consideration was given to this proposal. The Indian Standards Institution (ISI) with the approval of the Government of India, set up in 1948 a Special Committee to study the problem. After considerable thought and consultations, the Special Committee recommended the adoption of the metric system as the only system of weights and measures, replacing all other systems. It was agreed that in order to ensure a smooth changeover to the new system, the transition period should be spread over 11 to 15 years and that there should be a phased programme for the introduction of the reform. In the words of the Commitee"......its uniformity will lead to security to the masses in their day to day commercial dealings; its simplicity would result in a tremendous saving of time, money and energy in commercial and technical calculations and in education and training of the younger generation; its international character would help stimulate overseas trade, etc."

1. 1. 3 After due deliberations on the report of the Special Committee set up by the Indian Standards Institution, the Government accepted the proposal in April, 1955. It was further decided that the metric system of weights and measures should be introduced subsequent to the adoption of Decimal Coinage. A Standing Metric Committee was then appointed by the Government to plan the necessary details for the introduction of the new system and to suggest an outline of the necessary legislation in this connection.

1. 1. 4 The Standing Metric Committee at its First Meeting held on 22. 6. 1955 made the following recommendation:--

"Each Ministry should examine to what extent the changeover from the foot-pound system to the metric system will create any problems or difficulties for it which require the attention of the Committee, or which require action on the part of other Ministries or agencies, in order to ensure co-ordination and a smooth changeover. Such a study should be conducted either by a particular officer in each Ministry, or by a Committee to be set up within the Ministry, depending upon the nature and magnitude of the problems involved."

The Ministry of Railways (Railway Board) in pursuance of the above recommendation, set up an adhoc Railway Metric Committee in terms of Board's letter No. E55CO1|39|3 dated 20. 8. 1955 (Appendix I) with the following membership:

(1)	Shri S.L. Kumar, Director, Railway Testing and Research Centre.	Chairman.
(2)	Shri B. S.Sindhu, Chief Design Engineer Incharge, Central Standards Office.	Member.

(3)	Shri V. Venkataramayya, Chief Design Engineer (Civil), Central Standards Office.	Member
(4)	Shri L. C. Mohindra, Chief Design Engineer (Signals), Central Standards Office.	"
(5)	The Railway Liaison Officer.	"
(6)	Shri K. V. Kasturi Rangan, Joint Director, Finance (Establishment), Railway Board,	"
(7)	Shri R. E. de Sa, Joint Director, Civil Engineering, Railway Board.	"
(8)	Shri L. T. Madnani, Joint Director, Mechanical Engineering, Railway Board.	"
(9)	Shri G. D. Khandelwal, Joint Director, Traffic (Transportation), Railway Board.	"
(10)	Shri D. R. Suri, Joint Director, Traffic (General), Railway Board.	"
(11)	Shri D. S. Mehta, Deputy Director, Tele-Communication, Railway Board.	"

Due to the transfers of various officers, in the final membership, items 2, 3, 5, 6, 7, 8, 9 and 11 above were replaced by Sarvashri C. S. Lal, K. C. Sood, B. R. Kinra, H. Ramamoorthy, B. C. Ganguli, N. N. Tandon, P. C. Mathew and I. C. Bhatt respectively. Dr. B. Lall* Joint Director (Medical), Railway Board and Shri P. N. Murti, Electrical Advisor, Railway Board, were co-opted as members subsequently. Shri J. P. Gupta was appointed as whole-time Secretary of the Committee from Ist February, 1956.

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1.2 Scope of enquiry.

The Terms of Reference assigned to the Railway Metric Committee were:—

(a) How the changeover from the present system to the metric system should be effected.

(b) Phasing of the changeover.

(c) Financial implications.

1. 3. Method of enquiry.

1. 3. 1 At the inaugural meeting of the Committee on 15. 9. 55, it was decided that in order to collect the basic data on the subject, a questionnaire should be issued to all Railways. This questionnaire along with a covering note (Appendix II) was sent to all Indian Government Railways, Chittaranjan Locomotive Works, Integral Coach Factory and Central Standards Office on 4. 11. 1955.

1. 3. 2 While the questionnaire issued was under the consideration of the Railways, it became necessary to take a policy decision regarding future

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(* Now Chief Medical Officer, Northern Railway) indents of new machinery and plant in view of the proposed changeover to the metric system. A Memorandum (No. PCI/12/1 dated 15. 3. 56) was, therefore, submitted to the Board. The Board's orders on this Memorandum, vide their letters No. 55/964/2/M dated 28. 5. 56 and 28. 7. 56 (Appendix III) stipulated that machinery, plant and tools indented hereafter should be suitable for functioning on both systems and existing indents of equipment should be similarly modified to the extent possible. Another important issue referred to the Board (letter No. RMC/4 dated 20. 8. 56) was in regard to the desirability of simultaneously changing over to decimal coinage and metric system of weights and measures in respect of passenger fares and freight rates to avoid dual revision of tariffs etc. This is still under the consideration of the Railway Board.

1. 3. 3 The views and comments of the Railways in respect to our questionnaire were received by July, 1956. Based on these comments, a draft Report giving the important implications of the adoption of the new system, the programme during the transition period and the estimated additional expenditure involved, was prepared. The draft Report was considered at a meeting of the Committee held on 17. 9. 1956 and a few changes were adopted. The modified Report was then circulated to the Railways in September, 1956. The Committee further decided that it would be necessary to appoint a Sub-Committee for carrying out further discussions with the representatives of the Railways and for preparing the final draft of the Report. A Sub-Committee consisting of the following members was set up:—

(1) Shri K. C. Sood, Chief Design Engineer (Civil), Central Standards Office.	Chairman.
(2) Shri N. N. Tandon, Joint Director, Mechanical Engineering (Works), Railway Board.	Member.
(3) Shir H. Ramamoorthy, Deputy Director, Finance (Expenditure), Railway Board.	Member.
(4) Shri J.P. Gupta, Secretary, Railway Metric Committee.	Member.

The Sub-Committee undertook extensive touring during November and December, 1956 and completed the Final Report in February, 1957. The Final Report was considered and, after a few modifications, approved by the main Committee at a special meeting held on 28.2. 57. A list of places visited by the Sub-Committee and officials interviewed, and particulars of Committee metings is given in Appendices IV and V respectively.

1. 3. 4 One of the terms of reference relates to the financial implications of the changeover to the metric system. We have given considerable thought to the nature and extent of the problems that will arise in various branches of railway working. Discussions on financial issues were also held with the representatives of all branches of the Railways. We could, however, only assess the general nature of the work involved in this changeover and it has been found extremely difficult to visualise the exact magnitude of the work-load at this stage.

The estimates of the likely additional expenditure for bringing about this change as submitted by different Railways reveal a wide disparity. In the absence of any factual assessment of the work-load, these fluctuations in the estimated costs are understandable. As a result of the exchange of views with the representatives of the Railways, an attempt has been made to prepare a more rational estimate of the cost of work. The estimated cost for each branch of Railways, as indicated in the relevant chapter, is based on the assumption of equal work-load on each Railway and does not represent the actual requirement. The cost on each Railway will, however, vary from the estimated figures outlined in our Report. We do not, however, hesitate to record that in spite of discussions with the Railways and of considerable thought given to the subject, the estimates of costs prepared by us cannot but be very approximate.

1. 3. 5 It was basically necessary to maintain a close liason with the Standing Metric Committee appointed by the Government of India and the Indian Standards Institution to watch the progress made by these two bodies in regard to the important policy decisions and fixation of new standards respectively. We, therefore, kept in touch with these bodies in order to align our recommendations with the broad policy decisions of the Government of India and with the Standards drafted by the Indian Standards Institution, for the changeover to the metric system.

1. 4. The Standards of Weights and Meassures Act, 1956.

A Copy of the Standards of Weights and Measures Act, 1956 is placed as Appendix VI. This Act provides for the establishment of standards of weights and measures based on the metric system with the following important features:—

(a) Provision of a total transitional period of ten years from the date of passing of the Act.

(b) Use of international nomenclature for the primary units of length (metre), mass (kilogram), time (second), electric current (ampere), temperature (degree centigrade), luminous intensity(candela), area (square metre), volume(cubic metre) and capacity (litre). The exact definitions of these primary units are also given.

(c) Schedule of conversion of existing weights and measures into the metric weights and measures.

1. 5 Layout of the report.

1. 5. 1 The engineering branches of the Railways constitute one of the largest units of established industry in the country. Since the impact of the proposed changeover will be felt most by the engineering establishments, we have attempted to lay down the results of our investigations in such a manner as to bring out the numerous difficulties and problems which will arise in the engineering branches of the Railways.

1. 5. 2 There are, however, certain essential preliminaries which must be carried out by trade and industry with a view to presenting a rational and co-ordinated sequence of actions necessasy on Railways. We have outlined in chapter II some of the essential preparatory steps, generally necessary in the country without which a changeover on Railways will not be feasible.

1.5.3 In chapter III, we deal with the administrative and organisational measures which will be nesessary at the various administrative levels in the railway organisation. The important measures commo to all branches of railway working have also been detailed in this chaptenr.

1. 5. 4 All work in regard to designs and specifications of standard equipment used by various engineering branches of the Railways has been assigned to the organisation known as the Central Standards Office for Railways. It will be generally appreciated that this technical organisation would, therefore, play an important role in studying the implications and working out the line of action for the adoption of the metric system. We have, as such, considered it necessary to deal with this organisation in chapter IV before undertaking an examination of the problems which will eventually affect the individual engineering departments. It has been brought out in this chapter that this office would primarily be responsible for undertaking all work in connetion with the modifications to designs and drawings of standard equipment.

1. 5. 5 In the subsequent chapters (chapters V to XIII) we have dealt with the details of the action necessary in the major branches of railway working and have also generally outlined the phases of the changeover including the financial implications. We have not considered it nesessary to give similar details in respect of miscellaneous Railways branches such as the Railway Security Force, Rail-Road Co-ordination Services etc., as the impact of the changeover in these branches would be insignificant. Any action found necessary in these branches, has been generally coverd by the common measures outlined in chapter III (para 3.2).

1. 5. 6 In conclusion, we have made in chapter XIV, a general assessment of the approximate estimated cost of, and the period for, the complete changeover on the Indian Railways.

1. 5. 7 We have given a brief summary of the financial implications of the changeover to the metric system on Railways in chapter XV. A summary of our recommendations is given in chapter XVI followed by appendices to which references have been made at appropriate places in the report.

CHAPTER II

GENERAL PREPARATORY STEPS

2.1 The standardisation of weights and measures on the basis of the metric system, will be, one of the most important reforms of the century in the country and will bring about a near revolution in India's commerce and trade, particularly in the field of engineering industry. In initiating such a major reform, unilateral or isolated action by any one enterprise or industry is not practicable. The changeover must, therefore, be effected in close co-ordination with the various concerned interests.

2.2 In order to ensure a smooth and gradual changeover to the metric system on Railways, some of the general preparatory steps considered necessary in the public and private sectors, are outlined below:—

2.2.1 Extensive publicity and propaganda of the new system in the country through all available means of publicity; supply and distribution of conversion tables and equivalents in English, Hindi and regional languages. Introduction of the widest possible measures in all educational institutions to acquaint the students with the metric system and to popularise this system throughout the country.

2.2.2 Manufacture and early supply of sufficient quantities of standard metric weights and measures. In the interim period, until the indigenous industry is sufficiently developed, procurement from abroad may have to be considered. This may be particularly desirable for industrial establishments where large numbers of skilled, semi-skilled and unskilled staff will need to be trained in the use of new measuring scales and equipment.

2.2.3 Preparation of new standards by the Indian Standards Institution. This work should be given top priority as in all technical establishments the progress towards the changeover will depend on the availability of the new standards. Availability of technical reference books, data sheets, tables, constants, all types of specifications and limits and fits etc., in the metric system will have to be ensured.

2.2.4 All sections of the trade and industry, both in the public and private sectors, should initiate preliminary action for the changeover and plan to design their new schemes of development on the metric basis. It will be equally important for all commercial and industrial undertakings to adopt the metric system in the current lines of production in a co-ordinated manner.

2.2.5 All new steel mills should be designed to roll the metric sections from the commencement of their production. Similarly major expansions of existing steel mills should be planned so as to ensure production on the metric system. The existing capacity in the steel plants should also be gradually changed over for production to the new system.

2.2.6 Co-ordinated planning of the phases of this reform in the various spheres in order to avoid set-backs to national economy should be carried out by the Central Authority

2.2.7 The metric system should be gradually and progressively introduced in trade and in everyday public use, so that the population may not feel "lost" if the changeover was sudden and without prior preparatory steps for educating the public in various ways to get conversant with the new system.

CHAPTER III

ADMINISTRATIVE AND ORGANISATIONAL MEASURES

3.1 The adoption of the metric sysetm of weights and measures necessitates a planned changeover from the present system and proper co-ordination between all branches of Railways, so as not to jeopardise the efficient standards in railway maintenance and operation. The Railways will, therefore, be called upon to take adequate administrative and organisational measures. These may be broadly divided in two parts:—

I Organisation in the Railway Board's Office,

II Organisation at the Headquarter Offices of Railways.

3. 1. 1. Organisation in the Railway Board's Office.

3.1.1.1 We are of the view that the proposed organisation in the Railway Board's Office should be in the form of a small cell under the Additional Member Mechanical. An Officer of adequate status should be placed in charge of the cell. We generally feel that the Mechanical Engineering Branch of Railways will carry the maximum load during the transition period and, as such, it would be desirable to place this cell under an Officer of the Junior Administrative grade of the Mechanical Engineering Department. It will be necessary to provide representatives of the Civil Engineering and the Stores departments in this cell, as these branches will also be faced with numerous problems for bringing about the changeover to the metric system. The provision of a Deputy Director from each of these two branches, is, therefore considered desirable. It will also bo necessary to provide, for sometime, a Deputy Director, Traffic (Transportation and Commercial), in the cell. Adequate office staff will also be required for the proposed Railway Board Metric Cell.

3. 1. 1. 2 Principal functions of the Cell.

The principal functions of this Cell would be to plan and direct the changeover to metric system on Railways in close co-ordination with the Central Government (Standing Metric Commitee), Indian Standards Instituttion, State Governments and commercial and industrial organisations. Some of the important functions are mentioned below:—

(a) To plan the introduction of the reform so as to ensure complete co-ordination of the actions in all branches of railway working.

(b) To arrange revision of Railway Board's codes and publications.

(c) To review from time to time the organisational set up in the zonal railways for effecting this changeover.

(d) To arrange for the progressive and phased introduction of the metric units in all railway statistics.

(e) To deal with other allied matters.

3.1.1.3 The adoption of the metric system of weights and measures has initially been planned to be completed over a period of 15 years. This transitional period has since been reduced to 10 years. It will, therefore, be essential to execute all preparatory steps at an accelerated pace to keep within the target of the transitional period and we recommend that the Railway Board Metric Cell should be set up immediately. From the principal functions of the Cell, it will be observed that the Cell would, in the preparatory period, be required to issue policy directives to Railways in close co-ordination with various other agencies. We, therefore, visualise that the above cell will be required to function for a period of 3-5 years.

3.1.1.4 We would like to stress here that the first important function of this cell would be to arrange for early revision of the Railway Board codes and publications, particularly the Schedule of Dimensions and the IRS Limits and Fits as all work in the Design and Drawing Offices would be dependent on the early issue of these two publications. We, therefore, recommend immediate action in this connection.

3.1.1.5 Financial implications-It is roughly estimated that the expenditure involved in the setting up of the proposed metric cell in the Railway Board's Office will be of the order of Rs. 4 lakhs spread over a period of 3-5 years.

3. 1. 2. Organisation at the Headquarter Offices of Railways.

3. 1. 2. 1 We have in the foregoing paragraphs dealt with the organisational set up in the Railway Board's Office. The establishment of Metric Cells in various branches of Railways at each Headquarter Office will be similarly necessary. The Railway Heaquarter Cells will be charged with the function of translating into action the policy directives issued by the Railway Board. We have had discussion with the representatives of various railways on the size and pattern of the set up of the Cell/Cells at the Headquarter Offices. They were generally of the opinion that it would be necessary to establish a small nucleus cell in each branch under the control of the respective Head of Department. There was, however, a considerable divergence of views in the matter of co-ordinating agency. Some Railways were of the opinion that the Senior Deputy General Manager or Deputy General Manager (General) should carry out this co-ordination and should be assisted by an additional Senior Scale Officer for this purpose whereas others felt that an additional post of Deputy General Manager (Metric System) would be necessary. There was yet another suggestion that a Junior Administrative Grade post should be created either in the Mechanical or in the Civil Engineering Metric Cells and this Junior Administrative Grade Officer should perform the dual functions of introducing the reform in his department and carrying the responsibility of co-ordination, assisted by a Junior Scale Officer, if necessary. While we are not in favour of any strict regimentation in regard to the co-ordinating agency, except that it should be of a sufficiently high status so as to be able to discharge this function efficiently, we recommend the setting up of separate Metric Cells in each department in the Headquarter Offices of Railways. The strength of gazetted staff for the various departmental cells, should, in our opinion, be as under:—

(a) Civil Engineering Department.
One Senior Scale Officer.

(b) Mechanical Engineering Department.
One Senior Scale Officer.
(In addition, Junior Scale Officers will be required for manning 'Planning Cells' at major workshops. (Please refer to Chapter VI, para 6. 4. 10.)

(c) Signal & Tele-Communication Engineering Department.
One Junior Scale Officer.

(d) Electrical Engineering Department.
One Junior Scale Officer.

(e) Stores Department.
One Senior Scale Officer.

(f) Traffic & Commercial Departmnts.
One Junior Scale Officer.

(g) Medical Department.
A Nominated Officer.

(h) Accounts Department.
One Junior Scale Officer.

3. 1. 2. 2. It may also be stated here that adequate office staff will be required for the proposed Departmental Metric Cells mentioned above. The strength of the non-gazetted staff for the departmental cells may be worked out by the local administrations in relation to the work-load offering.

3. 1. 2. 3. Our investigations reveal that the preparatory phase for the Engineering Departments, particularly the Mechanical and Civil Engineering Branches, may last for a period of about 5 years. On the other hand, all work in connection with this changeover including the preparatory phase in the Commercial & Traffic Branches will be completed in about 3 years. We are further of the opinion that the Electrical and Signal & Tele-communication Engineering Branches would require a minimum of 3 years preparatory period. It will, therefore, be appreciated that the duration of the Departmental Metric Cells in the Headquarter Offices will vary in each department and it may also not be necessary to establish them simultaneously. Presuming that the Metric Cell in the Railway Board's Office is set up early in 1957, we suggest that the Departmental Cells on the Railways should be established as follows:—

(a) Civil Engineering Department.
4-5 years (Mid 1957 to 1962).

(b) Mechanical Engineering Department.
5 years (Mid 1957 to 1962).

(c) Signal & Tele-communication Engineering Department.
2 years (Mid 1958 to 1960).

(d) Electrical Engineering Department.
3 years (Mid 1958 to 1961).

(e) Stores Department.
5 years (End of 1957 to 1962).

(f) Traffic & commercial Departments.
2 years (Early 1958 to 1960).

(g) Accounts Department.
2 years (Mid 1959 to 1961).

3. 1. 2. 4. We also examined the necessity of creating special Cells at the Divisional or District levels. We are in agreement with the views generally expressed by the Railways that no special organisations need be

set up at these points, except for the additional staff required for specific works, such as training, conversion of drawings and plans etc. The requirements of such staff have been dealt with in the relevant subsequent chapters.

3. 1. 2. 5. Financial Implications—As stated earlier, the Railways' demands for the Headquarter Metric Cells in regard to gazetted staff were more or less identical. We also examined the proposals given by Railways in regard to the non-gazetted strength of the proposed cells and observed considerable disparity in their demands. Generally speaking, the cells will have to be manned by non-gazetted staff, such as stenographers, clerks, typists, etc., but the actual strengh of such categories of staff will naturally depend on the work-load in such departmental cells. We, therefore, suggest that the railway administrations be permitted to work out their requirements according to their needs. A rough estimate of the expenditure, which is likely to be incurred in the establishment of the metric cells in the Headquarter Offices for periods varying from 3 to 5 years, has been placed at Rs. 5. 5 lakhs per railway.

3. 2 Measures Common to All Branches of Railway Working.

In the subsequent chapters we deal with the detailed planning which will be necessary in the major departments. We, however, consider that measures which are common to all branches of Railway working, some of which require immediate attention, could be brought out here. These measures are discussed in the subsequent paragraphs.

3. 2. 1 Staff.

3. 2. 1. 1 The changeover to the metric system of weights and measures will throw considerable additional load on our Design and Drawing Offices and ways and means must, therefore, be found to recruit and train adequate number of additional draftsmen and tracers. It will be equally necessary to launch metric training schemes in various branches, particularly the railway workshops, so as to gradually acquaint and familiarise our staff with the new system.

3. 2. 1. 2 All Railways as also the representatives of the Central Standards Office expressed grave fears about implementation of this reform in the prescribed period of ten years, on account of the acute shortage of the draftsmen in our country. We were informed that even the present permanent cadres could not be fully utilised in the Drawing Offices and some Railways had vacancies in the region of 30 percent to 50 percent of the sanctioned strength. We also learnt that considerable dilution in regard to quality had already taken place and many tracers who were even remotely fit for promotion, were working as draftsmen. The Railways brought to our notice another important factor in this context which is considerably affecting the availability of draftsmen in railway drawing offices. We learnt that a large number of experienced draftsmen were leaving Railways to seek better opportunities of employment which were becoming available on an ever increasing scale in the private sector.

3. 2. 1. 3 We, therefore, feel that there is need for some radical measures so as to enable the Railways to find the large body of additional draftsmen required for the introduction of the metric system. We fully appreciate that the output of draftsmen from the various institutions in the country is limited and with a fast expanding economy both in the private and public sectors, Railways could expect only a small share out of this limited output. It will, therefore, be realised that Railways may have to recruit a large number of Engineering Diploma holders and Graduates and arrange to give

them intensified training for a comparatively short period of about 12 months. In order to attract the required number of diploma holders and graduates for the posts proposed to be created, it will be necesary to provide adequate number of higher grade posts. This will enable us to obtain the required number of men and retain most of them permanently. This is extremely important in view of the rapidly increasing work-load in our drawing offices.

3. 2. 1. 4 We understand that in other industrially advanced countries, the drawing offices in most technical establishments, are usually manned by engineering graduates with adequate avenues of promotion. In order to provide similar opportunities to our draftsmen, we are of the opinion that a few posts, particularly in the major drawing offices both in the Mechanical and Civil Engineering branches should be upgraded to gazetted ranks. We, therefore, recommend that the number of posts in the higher grade should be considerably increased and a few gazetted posts also provided.

3. 2. 1. 5 As indicated earlier, all branches on Railways will be called upon to work out suitable schemes for training their men for working to the metric system. It became evident during the course of discussions with Railways' representatives that there will be no serious difficulty in organising such training facilities and the additional staff required for this purpose, would be generally found through local promotions. We may, however, point out here that the suggestion put forward by one of the Railways for utilising supervisory trainees in workshops and other maintenance depots, is a sound proposal for imparting necessary training particularly to unskilled, semi-skilled and skilled staff as this would not involve any additional expenditure.

3. 2. 1. 6 Assuming that the educational institutions in the country will soon be laying greater emphasis on the study of the metric system in schools and colleges, we recommend that the agencies responsible for recruiting staff for Railways, should include an elementary test of the knowledge of the metric system in their syllabi.

3. 2. 2 Equipment and Stores.

3. 2. 2. 1 It will be desirable for the railway administrations to start planning a gradual changeover while working out their requirements of equipment and stores particularly of measuring scales and instruments. The latter are generally of a replaceable nature, for which the Railways have more or less, fixed annual demands. It will be appreciated that during the period of transition both types of measuring equipment would continue to be used. This should not, however, lead us to conclude that it would be necessary to double our assets of this nature. The introduction of the metric system should be planned so that during the normal replacement from year to year, the Railways procure the metric measuring equipment on a gradually increasing scale. Whereas in the initial stages of the preparatory phase, there would be limited procurement of the metric measures, primarily for the purpose of education of the staff, the tempo of replacement by the metric units towards the end of the preparatory phase would rise considerably and the procurement would be mainly confined to the metric measuring equipment. We do not, therefore, visualise that at any stage during the period of transition, the holdings of such equipment would increase beyond 30 percent to 50 percent above our normal requirements.

With regard to the acquisition of new machinery and plant, it may be recalled that the Railway Board have already issued necessary orders (Reference Board's letters No. 55/964/2/M of 28th May 1956 and 28th July 1956. Appendix III).

3. 2. 2. 2 Most of the machinery and plant installed in railway establishments have a serviceable life varying from 20 to 50 years. Our investigations revealed that it will not be necessary to carry out alterations to most of the machinery and plant for the purposes of adaptation for production in metric system except where screw cutting and gear cutting are involved. Recalibration of the inch graduations of machine tools installed in the production units—Chittaranjan Locomotive Works and Integral Coach Factory, will, however, be necessary.

3. 2. 2. 3 Recalibration of the weighing machines—Recalibration of the weighing equipment (weigh-bridges and weighing machines) will have to be carried out in all branches of Railway working. Calibration of equipment to the existing and to the new units is considered desirable during the transition period as the trade will gradually changeover to the metric system of weights. Since recalibration will generally be carried out by outside agencies and will have to be spread over a long period of time, an adhoc provision of additional weighing machines and weigh-bridges will be necessary. We, therefore, recommend that the Railways should initiate action in this matter at an early date.

3. 2. 3 Specifications, Codes and Manuals.

We have pointed out earlier that it would be necessary to revise the specifications, codes and manuals and other existing directives issued both by the Railway Board and the Railway offices. Those issued by the Board, will be revised by the Metric Cell to be set up in the Board's Office. Priority in this work should be given to the revision of Schedule of Dimensions and the IRS Limits & Fits. Local manuals of Railways should be revised early by the departments themselves.

3. 2. 4 Budgetary Provision.

The Railways would be required to make necessary budgetary provision as soon as they receive the Board's orders regarding the introduction of the metric system.

3. 2. 5 Publicity.

The Ministry of Information and Broadcasting will, no doubt, give wide publicity to the new system through all available media. The Publicity Branch of each Railway system as also in the Board's office, should give similar publicity through the various railway magazines & periodicals. It may even be desirable to issue special hand-outs and bulletins pertaining to the changeover.

CHAPTER IV

CENTRAL STANDARDS OFFICE

4. 1 General.

4. 1. 1 The general preparatory steps necessary in the country and on the railways outlined earlier in Chapter II and III respectively forman essential prologue to the consideration of the implications of changeover in the Central Standards Office. Some of the basic steps such as supply of new Indian Standards, conversion tables, etc. should necessarily precede any action in the matter of modification of drawings and preparation of new designs in the metric system by the Central Standards Office. This organisation of the Indian Railways has been engaged since its inception in the preparation of standard designs for the various engineering departments. We have already achieved a fairly high degree of standardization in many respects and we wish to emphasise that the proposed changeover to the metric system will involve almost a complete re-examination of our existing standards with a view to evolving new standards on the metric basis.

4. 1. 2 It will be generally appreciated that most of the work in regard to modification of standard drawings will be concentrated in the Central Standards Office. An estimate of the number of standard drawings reveals that as many as 35,000—40,000 drawings may have to be dealt with for this purpose.

4. 1. 3 We wish to emphasise at the outset that mere endorsement of the exact metric equivalents of inch dimensions on these drawings would have little practical utility because of :—

(a) The introduction of new rolled sections.

(b) The substitution of the existing standard small tools, such as drills, reamers, cutters, etc. by new standard sizes.

(c) The adoption of a completely new system of screw threads.

The element of re-designing would, therefore, be predominant and while converting any dimension to metric units, it would have to be examined from the designer's point of view keeping in mind the new metric standards. To illustrate this point, it would be appreciated that mere conversion of 1 in. hole dimension to 25.4 millimetres would be of little use since no drill of this size is expected to be standardized in the metric system. The nearest metric drill size may be 24 millimetres or 26 millimetres and the adoption of either of these sizes would need examination in relation to other parts in a particular assembly. Similar examination would be necessary wherever new rolled sections and new standards of small tools etc. have to be adopted. The metric screw thread design is entirely different from the existing screw thread and conversion of dimensions will not be possible.

4. 1. 4 It would perhaps be relevant to indicate here the views of a leading firm of manufacturers of rolling stock in Europe in regard to the proposed changeover to metric system in India. In response to a request from the Central Standards Office for including dual dimensions on the "as made" drawings against a particular order of locomotives, the firm advised that inclusion of dual dimensions on the "as made" drawings would not serve any useful purpose. They, in fact, recommended that the existing

standard equipment should be retained for their normal life without any modifications whatsoever and only the new designs should be developed on the metric basis.

4. 1. 5 Since, however, a substantial portion of our assets in the form of standard equipment will give useful service for several decades and as it would be extremely undesirable to perpetuate the transitional difficulties beyond a certain maximum period, we are of the view that the re-designing of the normally replaceable assemblies in our standard equipment including rolling stock, in order to adopt the new metric standards, would be inescapable. There would also be simultaneous development of designs for new standard equipment based entirely on the metric standards and the work may, for convenience, be broadly divided under two main categories:—

(a) Re-examination of the existing standard designs with a view to adopting the new metric standards.

(b) Development of new designs based on the metric units.

4. 1. 5. 1 As regards (a), we recommend that the re-examination should be confined mainly to our existing standard designs as most of the non-standard equipment including non-standard rolling stock are expected to completely go out of use by 1970. We feel that it would be futile to undertake any revision of designs and drawings of non-standard equipment which will not remain in service after 1970 except for any changes of a minor nature which may become necessary for the adoption of metric sizes of bolts and nuts, studs, set screws, etc. and that such changes should be considered and made only at the field level. We realise that the recently enacted legislation provides for a 10 year transition period and therefore, the changeover on the Railways should normally be completed by 1966. However, in view of the tremendous work-load involved in this changeover it will be only rational to minimise the range of equipment which should be considered for the purpose of re-designing on the metric basis, particularly when the usage and maintenance of railway engineering equipment would not generally involve any direct dealings with the public.

In regard to the standard designs and drawings of equipment which is expected to remain in use far beyond the year 1970, we recommend that re-examination for the adaptation of the new standards should be so carried out as to reduce the element of re-design to the minimum. We also wish to emphasise that an organization of the size of the Indian Railways cannot overlook the economics of the changeover and while re-designing, the leading dimensions of standard engineering equipment should, as far as possible, remain unaltered, even though the dimensions in terms of millimetres may work out in odd figures. This will obviously be essential in order to ensure the maximum degree of interchangeability between the original and newly designed components and assemblies.

4. 1. 5. 2 As regards (b), there should be no such restrictions and we recommend that the development of new designs should aim not only at the complete adoption of the newly developed standards but also result in such leading dimensions as will be convenient to trade and industry from the point of view of manufacture and usage. The only departure from this principle as visualised by us at present would be in the case of such assemblies of newly designed units, where it would be desirable to aim at some degree of interchangeability between them and their former equivalents on the foot-pound system modified, wherever required, for the adaptation to the metric standards.

4. 1. 6 It has been stated earlier in Chapter III that the introduction and the progress of the changeover to the metric system will depend considerably on the availability of the required number of draftsmen.

Though the overall requirements of additional designers as also the needs of various wings of the Central Standards Office will be discussed in subsequent paragraphs, we wish to emphasise here that only experienced draftsmen will be able to undertake the work of modification to the drawings as a varying element of re-design will be involved.

4. 2 Measures common to all wings.

4. 2. 1 Training of staff.

We do not visualise any difficulty in the matter of the staff of the Central Standards Office familiarising themselves with the new system and as such no special arrangements would be necessary for their initial training. It will, however, be most desirable to arrange for the early supply of new scales, conversion tables and the new standards on rolled sections, small tools including cutting tools such as drills and reamers, and screw threads. We are informed that the Indian Standards Institution is engaged in the preparation of new standards for the above items and most of them are expected to be completed during 1957.

4. 2. 2 Standard Designs and Drawings.

4. 2. 2. 1 We have stated earlier that most of the standard equipment and assemblies will require re-designing in connection with the introduction of metric system and as many as 35,000 to 40,000 standard designs and drawings will need revisions. The period for the complete change-over to the metric system has been fixed at 10 years and since it will be essential to complete the modification of designs and drawings within the preparatory phase, we recommend immediate action in this direction. This is particularly important as early availability of new designs for the existing standard equipment would enable the production units to commence manufacture on the metric basis and thereby reduce the future work-load on the maintenance workshops to effect the necessary changeover. The Central Standards Office should, therefore, be authorised to go ahead with recruitment and training of draftsmen immediately.

4. 2. 2. 2 Fears were expressed during the course of our discussions with various railways regarding the timely availability of the additional draftsmen for completing the above working during the preparatory phase. We share their apprehensions as there is a severe dearth of experienced designers in the country. One of the railway units put forward a suggestion, that if possible, this work of re-designing the existing standard equipment may be entrusted to a firm of Consulting Engineers in Europe. The new metric standards to be adopted in our country could be made available to the firm which could be asked to undertake the re-designing work in the light of these standards. This would, no doubt, considerably lighten the additional load on our Design and Drawing Offices which are already overstrained and at the same time make available the new designs in a relatively short period of time. We would, therefore, suggest that this avenue should be explored for this purpose.

4. 2. 3 Drawing Office Equipment.

4. 2. 3. 1 The selection of metric scales for use in Engineering Drawing Offices must necessarily precede any modifications to the existing drawings. The Indian Standards Institution has generally indicated the basis for the choice of metric scales and we recommend that the Central Standards Office should select suitable scales very early, and issue the necessary directive to all concerned. The Central Standards Office and the Railways should thereafter make necessary arrangements for the procurement of new scales.

4. 2. 3. 2 In regard to the additional equipment requird for the production of mechanical tracings and ferros, we would recommend that adequate arrangements should be made in order that sets of mechanical tracings and ferros can be prepared in the Central Standards Office for distribution to Railways. This will eliminate duplication of tracing work at various centres.

4. 2. 4 Specifications and Codes.

It will be generally appreciated that the Central Standards Office will be entrusted with the responsibility of the revision of IRS Limits and Fits, various IRS Specifications and Codes of Practices such as steel bridge Code, Steel Structure Code, Welding Code etc. It may be assumed that such of the Specifications of the Directorate General of Supplies and Disposals which are being used for procurement of railway stores will be revised by the Ministry of works, Housing and Supply.

4. 2. 5 Guidance to Railways.

It has been brought out earlier that the modification of drawings would involve a varying degree of re-design element. We have also generally accepted that the Central Standards Office will be more or less entirely responsible for carrying out the modifications to standard designs. Most of the Railways will, however, be called upon to undertake similar work for such non-standard equipment which is likely to remain in use beyond 1970. We fear that unless there is adequate co-ordination between the Central Standards Office and the Drawing Offices of various Railways in the matter of modification of drawings,the changeover may not be as smooth and uniform as would be desirable. We would, therefore, suggest that there should be frequent consultations between the representatives of the Drawing Offices of the Railways and the various Wings of the Central Standards Office.

4. 3 We have, in the foregoing paragraphs, generally dealt with the action which will be common to all the Wings of the Central Standards Office. We now deal with the detailed work in connection with the proposed changeover in the various branches of this organisation.

4. 4 Civil Wing.

4. 4. 1 It will be generally appreciated that the re-design work in the Civil Wing will be connected mainly with the adoption of new rolled sections. We have indicated before that the new standards for rolled sections will be finalised by the Indian Standards Institution some time in 1957. We further understand that indigneous production of rolled sections to metric sizes is likely to commence during 1959-60. While the use of imported rolled sections to metric sizes is already being made on a 'make-shift' arrangement, it will indeed be desirable to evolve our new standard designs for bridges and structures in advance of the availability of indigenously produced raw material to metric sizes. It will be relevant to add here that during the transitional period, rolled sections to the inch as well as metric sizes will be available and as such we will continue to make use of the existing standard designs as also the new metric designs.

4. 4. 2 Outlined below are some of the essential works to be undertaken by the Civil Wing of the Central Standards Office.

(a) Revision of the Schedule of Dimensions.

(b) Preparation of new standard drawings for bridge girders, structures, track assemblies etc.

(c) Revision of the Track Manual.

(d) Revision of the Indian Standard Codes i.e., Bridge Rules, Steel Bridge Code, Steel Structure Code, Welding Code, Reinforced Concrete Code, Plain Concrete Code, Rail Road Bridge Code, Pier and Abutment Code, Arch Bridge Code, Code for Earthquake Resistant Buildings and Structures, Code of Practice for Precast Concrete Products and Structural Members and Liquid Retaining Reinforced Concrete Structures Code.

In connection with item (b) above, we feel that while the rail section may not be altered,it will be necessary to redesign other track components, such as fish-plates, fish bolts and nuts, bearing plates, sleeper fittings etc. to conform to the new standards. Designs for track assemblies for turnouts, diamond crossings and slips will require modification. As regards bridges and steel structures, standard drawings of girders, platform sheds, tanks and tank stagings will also need revision.

4. 4. 3. Requirements of additional staff—We have discussed the proposals in connection with the additional staff required by the Civil wing of the Central Standards Office and we generally agree with their demands. The work-load in this Wing may for convenience be broadly divided in two main categories:—

(a) Revision of Codes and Manuals.

(b) Modifications of designs and drawings.

We suggest that an Assistant Chief Design Engineer (Senior-Scale) and a Sectional Officer along with adequate office staff may be provided for a period of about 3-5 years to complete the work outlined above. Furthermore an additional provision of the order of 8 design assistants, 10 draftsmen and 16 tracers may be necessary for a period of 3-5 years for undertaking the modifications of designs and drawings. We wish to emphasise once again that the percentage of higher grade design assistants and draftsmen should be adequate, so as to attract suitable men.

4. 5 Architectural Wing

We understand that not many standard plans have been issued by this Wing as special plans are prepared for different schemes. There are also no manuals and codes issued by this Wing and, therefore, the question of revision does not arise. The effect of the changeover on this Wing would therefore, be negligible and we are of the view that no additional staff should be necessary.

4. 6 Signal & Telecommunication Wing.

4. 6. 1 Our investigations in regard to the expected work-load in the Signal & Telecommunication Wing of the Central Standards Office reveal that the changeover to the metric system would call for the following additional work:—

(a) Revision of the Signal Engineering Manual.

(b) Revision of the Signalling portion of General Rules.

(c) Re-designing of existing standard signalling equipment.

It would perhaps be desirable to bring out the fact that unlike the advanced degree of standardization achieved in the Mechanical and Civil Engineering branches of the Railways, the process of standardization in this Wing was initiated only recently and though considerable progress has been made in standardizing various types of equipment, a substantial portion of the signalling assets on some Railways continue to be of non-standard designs. There are, however, 4,000 standard drawings issued by this Wing so far which will require modification in the preparatory stage.

4. 6. 2 Requirements of additional staff—We suggest that an Assistant Chief Design Engineer and a Sectional Officer with adequate staff may be provided for a period of 2-3 years to carry out this work. The Assistant Chief Design Engineer will be primarily responsible for revision of the Signal Engineering Manual and the signalling portion of General Rules and will also guide the Sectional Officer who will supervise the work of modification to standard drawings. Furthermore, additional provision of the order of 6 design assistants, 6 draftsmen and 8 tracers would be necessary for a similar period for revision of drawings.

4. 7 Loco Wing.

4. 7. 1 The maximum load with regard to the modification of designs and drawings will fall on the Loco Wing of the Central Standards Office. We were informed that as many as 26,000 drawings of standard locomotives would need examination. A number of locomotive parts are manufactured to fairly close tolerances. It would, therefore, be appreciated that unless the metric standard Limits & Fits are first evolved, it would hardly be possible to deal with any drawings in this branch. It would hence be necessary for the Loco Wing to undertake the compilation of the metric standard Limits and Fits immediately.

4. 7. 2 We have indicated earlier that the Central Standards Office would be entrusted with the work of modification of designs and drawings of all standard equipment. It may, as such, be accepted that the Loco Wing should deal with the following classes of locomotives:

(a) X Class (XA, XB, XC, XD, XE).

(b) W Class (WM, WL, WP, WG, WP/P, WT).

(c) Y Class (YB, YC, YD, YG, YL, YM, YP).

(d) Z Class (ZE, ZP, ZF).

(e) War time American locomotives (AWD, CWD, AWE, MAWD).

(f) HPS2.

(g) Diesel locomotives.

We are informed that many Railways have been undertaking preparation of part drawings of some of the above mentioned locomotives. This is evidently due to heavy arrears in the matter of preparation and supply of part drawings by the Loco Wing of the Central Standards Office and could not be altogether avoided in the interest of manufacture of spare parts. We further observed that some Railways had shown dual dimensions on the part drawings recently prepared by them. While we accept the interim necessity of the preparation of part drawings for the standard locomotives by various Railways, we wish to stress that the modification of drawings to the metric sizes should be undertaken only by the Central Standards Office. We may further repeat here that inclusion of metric equivalents of inch dimensions on part drawings will be of little value and should, therefore, be avoided.

4. 7. 3 The representatives of the Loco Wing of the Central Standards Office indicated that as many as 25 design assistants, 20 draftsmen and 25 tracers would be required to complete the modification work on 26,000 drawings in a period of about five years. While it is difficult to formulate any firm estimate of the actual requirements of additional staff for this work, we generally accept the requirements put forward by the Loco Wing.

We have expressed our doubts regarding the timely availability of such a large body of men, but even if they are made available, it would be difficult, without special arrangements, to find office and residential accommodation for so many men at Chittaranjan, where this Wing is at present situated.

4. 7. 4 On the other hand assigning some of this work to selected Drawing Offices of Railways, would not be desirable from the point of view of effective co-ordination and supervision of work. We would, therefore, suggest that immediate arrangements should be made for provision of the necessary additional office and residential accommodation at Chittaranjan for the additional staff of the Loco Wing of the Central Standards Office. Such accommodation may, in the first instance, even be of a temporary nature, in the form of hutments and tents. It would, however, be preferable to provide permanent accommodation, as even if some of it becomes surplus after about 5 years, it can be utilised by the Chittaranjan Locomotive Works including the new Steel Foundry, the activities of which are progressively increasing.

4. 7. 5 In addition to the main jobs of work outlined above, the Loco Wing will be called upon to undertake revision of the data sheets, Codes and relevant specification.

4. 7. 6 It has been explained earlier in this Chapter that re-designing of the normally replaceable assemblies of locomotives with a view to adopting the metric standards would be unavoidable. We, therefore, visualise that replacement, when due, of the existing foot-pound system assemblies by the metric assemblies to be manufactured in Railway repair workshops will be necessary and should preferably be carried out on a phased programme basis. It would, perhaps, be desirable to aim at a complete replacement of the normally replaceable foot-pound system duplicates during the period of transition so as to reduce the incidence of manufacture and stocking of spare parts on a dual system. We are of the opinion that the Loco Wing of the Central Standards Office should provide some general guidance to Railways in the matter of replacement of foot-pound system duplicates, particularly with regard to the sequence of changes.

4. 7. 7 Requirements of additional staff—The requirements of additional designers, draftsmen and tracers for this Wing have been generally indicated in para 4. 7. 3. We consider that two Assistant Chief Design Engineers (Senior Scale) along with adequate office staff should be provided in this Wing for a period of five years. In addition three Sectional Officers would also be necessary for a similar period for

supervising the work of modification of standard designs and drawings. We wish to repeat that an adequate number of higher grade posts in the categories of design assistants and draftsmen would be most essential in this Wing to deal with the modification work.

4. 7. 8 Before concluding our comments in regard to the Loco Wing of the Central Standards Office, we may emphasise that modifications of drawings for standard locomotives to be manufactured in the immediate future should be completed at the earliest opportunity so as to eliminate transitional difficulties in respect of such units, and recommend immediate action in this direction.

4. 8 Carriage and Wagon Wing.

4. 8. 1 The work handled by this Wing of the Central Standards Office mainly refers to the preparation of design/construction drawings and part drawings of standard rolling stock. Whereas a high degree of standardization has already been achieved in respect of wagon design, most Railways were, till recently building timber body coaches to their own designs. The introduction of all-metal coaches including those of the integral design would, however, lead to more rapid standardization in the field of coaching stock. This Wing will be called upon to undertake modifications of the drawings of replaceable assemblies of standard rolling stock (excluding integral coaches produced by Integral Coach Factory).

4. 8. 2 A fairly large number of steel coaches have been built by Messrs Hindustan Aircraft Limited and Jessop & Company Limited in recent years. Whereas Messrs Hindustan Aircraft Limited are changing over to the production of integral design coaches, Messrs Jessop and Company Limited are expected to continue the manufacture of conventional steel body metre gauge coaches for many years to come. We are of the view that this Wing should also undertake the revision and modification of drawings of the replaceable duplicates for the above coaches in order to ensure a maximum degree of interchangeability between the various types of coaching stock.

4. 8. 3 The estimates submitted by this Wing reveal that about 3,000 drawings (in terms of full size) will need to be examined with a view to re-designing. The above figure is exclusive of the drawings for coaches produced by Integral Coach Factory, Hindustan Aircraft Limited and Jessops and Electric Multiple Unit stock and Rail Cars.

4. 8. 4 As a result of our discussions we consider that provision of one Assistant Chief Design Engineer (senior scale), one Sectional Officer, about 6 design assistants, 8 draftsmen and 15 tracers along with adequate office staff would be required for a period of about 3 years to complete all work in connection with the introduction of the metric system. The additional staff indicated above will be responsible for undertaking the revision of any manuals or codes specially used in this Wing.

4. 9 Standard Electrical Equipment.

We have outlined above the nature of work to be performed by the existing Wings of the Central Standards Office. In the absence of an Electrical Wing in this Organisation, the Electrical Department of various Railways may have to undertake practically all work relating to the re-designing of electrical equipment. We are of the opinion that it would be desirable to set up early an Electrical Wing in the Central Standards Office so that much of the work common to all Railways in connection with the introduction of metric system could be centralised, thereby reducing duplication of work at various Railway Headquarters.

4. 10 Office Accommodation

During our investigations we learnt that all sections of the Central Standards Office were seriously short of Drawing Office accommodation. We were informed that a number of technical posts were vacant for want of suitable hands but we understood that even if suitable candidates could be found, it would not be possible to provide the necessary office accommodation. It will be evident from the figures of additional staff proposed for various Wings in the Central Standards Office that the Drawing Office organisation will undergo an increase of the order of 50 percent to 75 percent. Office accommodation will, therefore, be a serious handicap unless immediate steps are taken to make the necessary provision. We would, therefore, recommend that the necessary additional office accommodation for the Central Standards Office should be arranged on a priority basis.

4. 11 Financial Implications.

The approximate requirements of additional gazetted and drawing office staff for the various Wings of the Central Standards Office have been stated in the foregoing paragraphs. The approximate estimate of the total expenditure for the execution of the works connected with the introduction of the metric system in the Central Standards Office is as follows:

	Rs. in lakhs.
(1) Additional Staff:	
(a) Civil Wing for 3-5 years.	5.5
(b) Signal & Tele-comm. Wing for 2-3 years.	2.5
(c) Loco Wing for 5 years.	16.0
(d) Carriage & Wagon Wing for 3 years.	3.5
(e) Miscellaneous.	1.5
(2) Stationery, drawing office instruments and furniture.	1·5
(3) Printing Room materials and equipment.	11·0
(4) Additional office accommodation.	1.5
Total	Rs. 43 lakhs

CHAPTER V

CIVIL ENGINEERING BRANCH

5.1 General.

5. 1. 1 In this chapter we propose to deal with the problems arising out of the changeover to the metric system in the Civil Engineeing Branch. The phased action necessary for bringing about a smooth changeover has also been generally indicated in the subsequent paragraphs. This chapter should be read in conjunction with Chapters II, III and IV wherein the general preparatory steps necessary in the country, on the Railways and in the Central Standards Office, have been outlined.

5. 1. 2 We have stated earlier in Chapter III that it would be necessary to set up a Civil Engineering Metric Cell in the Headquarters organisation of each zonal railway. This Cell will, besides implementing the policy directives received from the Railway Board, be responsible for directing and co-ordinating the changeover in the Civil Engineering Branch on the railway system. We may emphasise once again that it will be desirable for this Cell to work in close collaboration with the cells of the other branches of the railways.

Some of the important functions of the Cell are outlined below :—

(a) Formulation of detailed instructions based on policy directives received from the Railway Board Metric Cell.
(b) Arrangements for training of staff.
(c) Revision of local manuals, schedules of rates, specifications, etc.
(d) Re-design of type plans.
(e) Estimation of requirements of metric measuring equipment and their introduction on a progressive scale.

(f) Introduction of kilometre markings on index plans and sections.

(g) Co-ordination with other Headquarter Cells so as to ensure a uniform and smooth changeover in all branches of railway working.

5. 1. 3 We have enumerated earlier in Chapter IV the various codes and manuals of the Civil Engineering Branch which would require revision in connection with the introduction of the metric system. We wish to bring out here that unless some of the basic Codes mentioned below are revised, it would not be possible for the railways to initiate any work towards the changeover :—

(a) Schedule of Dimensions.

(b) Way and Works Manual.

(c) State Railway Engineering Code.

We would, therefore, recommend that immediate action should be taken for the revision of the above mentioned codes so that the railways may commence their preparatory phase as early as possible.

5. 2 Our discussions with the representatives of the Civil Engineering Department on various railways lead us to the conclusion that the implications of this changeover may be considered under two broad categories, viz :

(a) Maintenance and

(b) New Works.

The problems in connection with the introduction of the metric system in the sphere of 'maintenance' would normally relate to the training of staff, replacement of existing measuring equipment, revision of basic records, revision of local manuals, schedules of rates, specifications etc., adaptation of plant and equipment and alteration to field markings. In the sphere of 'New Work' we propose to deal with the general issue relating to them.

5. 2. 1 Maintenance.

5. 2. 1. 1 Training of staff.

Most of the supervisory staff including the Assistant Inspectors will not require any special course of training for familiarising themselves with the new system though it will be necessary to make available to them the new measuring scales and equipment and conversion tables. We are in agreement with the views expressed by the railways that it will be necessary to make special training arrangements for all Class IV and artisan staff as also Works Supervisors, Head Mistries and Mates etc. It would be appreciated that as such staff are distributed all over the line, it would be extremely difficult to train them at a few centralised points. We would, therefore, recommend the provision of roving Instructors of the status of Inspectors or Assistant Inspectors for this purpose. While the requirements will vary according to the local conditions, we are generally of the view that one roving Instuctor per Division would be required for a period of one year. Though we do not visualise the necessity of establishing any special training centres for the supervisory staff, we would suggest that elementary knowledge of the metric system should form a part of the course of instructions at various training centres for new entrants as well as for the employees already in service.

5. 2. 1. 2 Replacement of existing measuring equipment.

We have indicated in Chapter IV the need for early decision regarding the selection of new scales for use in the Engineering Drawing Offices so that the railways could adopt the new scales for their normal work. Of the other measuring equipment the important ones that will require replacement to the metric units will be :

(a) Chains.

(b) Levelling Staffs.

(c) Tapes-both steel and metallic.

(d) Box-wood folding rules.

(e) Sets of Weights.

(f) Thermometers.

The procedure for gradual replacement of such measuring equipment has been generally discussed in Chapter III, paragraph 3. 2. 2. 1.

5. 2. 1. 3 Revision of basic records.

5. 2. 1. 3. 1. A large number of imporant basic records would require examination with a view to incorporating the metric units. Briefly outlined below are the important changes which should be effected in the various basic records :—

(a) Index plans and Sections.

We find that complete revision of the Index plans and Sections to show metric dimensions would involve considerable amount of work. We feel that at this stage, it should suffice to show longitudinal distances in in kilometres on index plans and Sections. This would enable the fixation of the new kilometre posts in the field which is discussed later in this chapter. We may however add that in fixing the kilometre points no attempt should be made to rectify the existing errors in respect of short and long miles.

(b) Yard Plans.

The Railways were generally of the opinion that revision of the existing yard plans to show metric units should be undertaken only when large scale re-modelling or other major changes were contemplated. We are generally in agreement with this view and do not recommend whole-sale revision of all yard plans at this stage. We appreciate that the station working rule diagrams which are evolved from the yard plans, will need to be redrawn to show metric distances as these are required for day to day working by various departments. We do not, however, anticipate any serious difficulty in undertaking this work even in the absence of yard plans, redrawn completely to metric scales.

(c) Land Plans.

The land plans require certification by State Governments. Railway need not, therefore, undertake any change until the state Governments alter theii records. The kilometre marks may, however, be shown on the land plans

(d) Lists of Infringements, Bridge Registers, Level-crossing Books etc.

It will be necessary to include metric dimensions in these records. Foot-pound system dimensions should be deleted only when any of these records are re-(compiled)

(e) Gang Charts.

Gang Charts based on kilometre distances will need to be issued soon after the fixation of the kilometre markings along-side the track. Slight adjustments in the strength and beat of gangs may thereby become necessary.

(f) Completion and Record Plans.

These will not require any alteration except in special circumstances such as, major modifications to existing structures.

(g) Type plans.

New type plans based on the metric units would be required for staff quarters, station buildings, ash-pits, etc. It would be advantageous to show both metric and inch dimensions on these plans during the transition period. The Indian Standards Institution is preparing a new Standard for metric building modules and this may be found useful in preparing new type plans.

5. 2. 1. 3. 2 It is obviously difficult to formulate even a rough estimate at this stage of the additional staff in various categories which will be required to implement the changes enumerated above. As a result of our discussions with the Railways, we generally accept that the requirement of additional draftsmen and tracers will be in the region of 1 Chief Draftsman, 10 Senior Draftsmen, 12 Junior Draftsmen and 16 Tracers per railway for a period of about 3 to 4 years for effecting the modifications to about 5,000-7,000 drawings and plans. As regards the other categories of staff, we do not propose to lay down any average estimate as the requirements may vary considerably from railway to railway.

5. 2. 1. 4 Revision of Local Manuals, Schedules of Rates, Specifications, etc.

We wish to emphasise the need for early revision of the schedules of rates, specifications and local manuals and rule books etc. as these are regularly made use of in the routine maintenance of track and buildings. The Indian Standards Institution is expected to issue a new Standard on units for measurements of building works executed during 1957, and we would suggest that revision of the schedules of rates should be undertaken soon after. If the revision is carried out before 1-4-60, separate revision for coinage and measures could be avoided. We appreciate that sufficient supplies of metric measuring equipment may not become available by this time and measurements for purposes of payment may still have to be taken in foot-pound system units. There should, however, be no difficulty in converting the final quantities into metric units.

5. 2. 1. 5 Adaptation of Machinery and plant —The impact of the change-over in regard to machinery and plant will be mostly felt in the Mechanical Department, and we, therefore, propose to discuss this aspect in detail in Chapter VI.

5. 2. 1. 6 Alterations of Field Markings. Field markings such as track mileages, bridge particulars, water tank capacities, etc. will require suitable alterations. These are discussed in the subsequent paragraphs.

(a) Kilometre Posts: The most important of the above will be the fixation of the kilometre posts and the consequent alterations to telegraph pole number plates. As soon as the kilometre points have been shown on the index plans and the standard design of the new kilometre post has been evolved by the Central Standards Office, arrangements should be made to fix the kilometre posts along the track. For determining the location of the new posts, the nearest existing mile post should be utilised for measurement to avoid cumulative errors which would otherwise arise due to inaccuracies in locations of some of the existing mile posts. Once the distance of the kilometre post from the nearest mile post has been determined by the Headquarter Metric Cell, the fixation of the new kilometre posts can be undertaken simultaneously by all field inspectors. This work need not await the supply of metric tapes and chains as the locations of the new posts can be given in terms of feet from the nearest mile post. The existing mile posts may also be retained for some years.

(b) Telegraph Pole Number Plates : It would be necessary to alter the markings on telegraph poles as soon as the new kilometre posts have been fixed. There is, at present, no uniform system for the telegraph pole markings. Some railways provide separate plates which are fixed to the poles whereas others have adopted the practice of painting the numbers on the poles. As is generally known, there is also no uniformity in regard to the number of telegraph posts in a mile. The assignment of new numbers to telegraph posts will, therefore, have to be carried out by the field staff.

Our investigations reveal that it would be necessary to have duplicate markings on the telegraph posts till all the relevant records of the area have been revised. A suggestion was put forward that duplicate number plates should be arranged for the interim period. We are, however, of the view that where the existing number plates can be re-used, the new number should be painted on the pole itself for the interim period but in case where the existing plates are of cast iron or enamel and which cannot be re-used, the new number plates of distinctive shape should be provided in the first instance as this would be found to be more economical.

(c) Bridge particulars, water tank capacities, etc: All markings on bridges, tunnels, water tanks, etc., are at present in the foot-pound system units. With the changeover to the new system, these would require alteration to metric units. In some places where the existing description boards or plates cannot be re-used, they may require replacement.

5. 2. 2 New Works.

5. 2. 2. 1 We have discussed in Chapter IV the problems of development of new designs based on metric standards. We do not anticipate that it would be possible to evolve new major designs in metric units until 1959 as considerable time would be required to revise our existing codes and manuals and obtain metric drawing instruments.

The Railways are already carrying out a large number of new works in connection with their development schemes during the Second Five Year Plan. These new works pertain to either construction of new lines or other assets such as Workshops, Loco Sheds, staff quarters etc.

and expansion of existing facilities. The introduction of metric system will have considerable impact on the progress of these schemes and too hasty a change in this sphere may not be desirable. We would, therefore, suggest that no change should be made with regard to works which are under execution, and planning on the foot-pound system should continue for all works likely to commence before 1960—61. If certain construction materials required for these works are not available in the foot-pound system units by the time these works are taken in hand, changes on a 'make-shift' basis could be made. We, however, recommend that 'New Works' which are likely to commence after 1960—61, should be planned on the metric system. It is likely that some works planned to be commenced before 1960—61 may subsequently get postponed and new designs on metric units may have to be prepared in such cases, but this cannot be avoided altogether.

5. 2. 2. 2 We have stated earlier that new measuring equipment should be obtained on a gradually increasing scale. We visualise that during the transition period some of the Engineering Inspectors and other supervisory staff may not possess both types of measuring equipment. It would, therefore, be advantageous to indicate the metric and inch dimensions on Type and other plans—particularly in regard to leading dimensions—prepared during the transition period so that no difficulty is experienced at the time of execution.

5. 2. 2. 3 With regard to surveys for new lines, the changeover to metric system should be effected as soon as metric surveying instruments become available. We understand that the Survey of India do not propose to make any changes in their maps for the time being. These maps are used by the Railways in connection with survey of new lines, but we do not anticipate any difficulty in data given on Survey of India Maps being converted to metric units when such surveys are undertaken by the Railways.

5. 2. 2. 5 We have stated earlier that no alterations would be necessary to the completion records and plans of existing structures except under special circumstances when any additions or alterations are to be made. The completion plans and records of projects now under execution or to be commenced during the transition period should, as far as possible, include the metric equivalents against the leading dimensions. Such a course would eliminate the necessity of any alteration at a later stage when major additions become necessary.

5. 3 The Commercial department of the Railways would require kilometre distances from station-to-station in connection with the preparation of new rate and fare tables based on metric units. The desirability of introducing the new system simultaneously for monetary values and weights and measures by 1-4-60 in the Commercial department, will be discussed in Chapter XI. This could be implemented only if station-to-station kilometre distances were made available to the Commercial department before the end of 1957 as they would require approximately 12—18 months to prepare the new fare and rate tables. We would, therefore, recommend that the Civil Engineering Department of Railways should, as soon as possible,calculate the kilometre distances from the mileages given on the longitudinal sections, in advance of the actual fixation of the kilometre posts and supply the necessary information to the Commercial department. We do not anticipate any difficulty in timely completion of this work, as use should be made of the ready reckoners in the form of detailed conversion tables being issued by the Indian Standards Institution. The rounding off of the calculated distances, should be carried out to the second place of decimal.

5. 4 Phasing of the changeover.

Both systems will co-exist for a period of about 10 years in the Civil Engineering Branch. The planning of new projects on the metric basis will depend on the speed with which the engineering industry and producers of raw materials changeover to the metric system. The period of changeover could be divided into preparatory and final phases each lasting for about 5 years. We, therefore, visualise that the foot-pound system would be more or less eliminated in the Civil Engineering Branch by 1967. The important features of the phasing are summarised below :—

5. 4. 1 Preparatory Phase—5 years (1957—1962).

(a) Setting up of a Civil Engineering Metric Cell in the Railway Headquarter Offices (Ref. Chapter III)—June 1957.

(b) Supply of calculated station-to-station kilometre distances to the Commercial department for revision of fare and rate tables—by November 1957.

(c) Procurement of metric measuring equipment on a gradually increasing scale—to commence as early as possible.

(d) Creation of training facilities—by December 1958.

(e) Revision of manuals, codes, schedules of rates, specifications etc.—by March 1960.

(f) Fixation of kilometre posts and substitution of telegraph pole markings—by March 1960.

(g) Survey for new lines on metric basis—April 1960 onward.

(h) Revision of type plans, basic records such as Index Plans, Bridge Registers, Level-crossing Books, Lists of Infringements etc.—by December 1960.

(i) Execution of new works on metric basis—from sometime in the period April 1960 to March 1961.

(j) Revision of description boards, bridge particulars, water tank capacities, etc.—by December 1961.

5. 4. 2 Transitional Phase—5 years (1962—1967).

(a) Gradual elimination of field markings in the foot-pound system.

(b) Gradual elimination of the foot-pound system measuring articles.

5. 5 Financial Implications.

All Railways will be called upon to introduce the metric system of weights and measures on a uniform basis in various fields of their activity. Our discussions with the representatives of the Civil Engineering Department revealed a considerable degree of variation in the size of their proposed requirements of additional staff and equipment. It will be appreciated that the over-all load in this connection will vary from railway to railway and as such we propose only to indicate broadly a rough estimate of the average cost of changeover.

The approximate break-up of the over-all cost against the important items of work in the Civil Engineering Branch of a zonal railway is summarised below :—

Items of work	Estimated average cost per railway
Civil Engineering Department Metric Cell at Railway Head quarters.	(Included in Chapter I
Training of staff. ..	Rs. 50,000
Gradual replacement of existing measuring equipment, small tools etc. and adaptation of machines and plant to metric system.	Rs. 1,00,000
Fixation of kilometre posts. ..	Rs. 1,25,000
Fixation of telegraph pole number plates..	Rs, 2,00,000
Revision of bridge particulars, water tank capacities etc. ..	Rs. 50,000
Revision of basic records. ..	Rs., 5,00,000
Revision of local manuals, schedules of rates, specifications etc. ..	Rs. 50,000
Total	Rs. 10,75,000

(Say Rs. 11 lakhs per railway)
i.e. Rs. 77 lakhs for all railways.

CHAPTER VI.

MECHANICAL ENGINEERING BRANCH.

6. 1 General.

6. 1. 1 The replacement of the foot-pound system of weights and measures by the metric series in the Mechanical Department will raise numerous problems and difficulties as the main impact of this changeover will be felt by the engineering industry in the country. It may not be out of place to recall here the reactions of some of the representatives of the engineering industry when the proposal was first mooted. Fears were expressed particularly by the established structural engineering industry that this change was bound to retard the progress of the rapid industrialisation of the country. We have given expression to these views in the beginning, not in order to suggest that the changeover in the engineering industry would lie in the realm of impossibility, but merely to caution those incharge of industrial establishments that considerable thought and planning would be essential. It must, however, be recognised that temporary minor set-backs in out-turn would be unavoidable in spite of the most careful pre-planning.

6. 1. 2 We deal in the subsequent paragraphs with the main problems and the phased action which will be necessary in the Mechanical Branch of Railways. A period of 5 years (1957 to 1962) for the preparatory phase is being suggested for this branch and we wish to emphasise that it would be necessary for the trade and industry to initiate early action so that Railways could receive adequate supplies of raw materials, tools and equipment in the metric system within this phase. It has been assumed that the industry at large would respond to the call of the Government and that Railways would be able to procure their supplies progressively on the metric system even in the early part of the transition period.

6. 1. 3 While working out the details for the adoption of the metric system in the Mechanical Branch of the Railways, it will be necessary to keep in view the general basic steps which have been discussed in the earlier chapters. Before proceeding with the discussion of the important aspects in greater detail, we may mention at the outset that unlike other departments, a vast majority of assets of this branch are in the form of rolling stock with numerous replaceable assemblies which require renewal at periodical intervals. While there is a school of thought in favour of retaining our existing stock in the foot-pound system and consequently continuing the production of their spare parts according to the original designs, we do not hesitate to point out that this would lead to a perpetuation of the dual system for a very long period and it would not be conducive to productive and operational efficiency on railways. We do, however, appreciate that such of the components of rolling stock as are not normally replaced during the life-time of a unit should not be interfered with, and the existing components should be retained till the end of their life.

6. 1. 4 It has been indicated earlier in Chapter IV that the Loco and Carriage & Wagon Wings of the Central Standards Office would be primarily responsible for the modifications to designs and drawings for all types of standard rolling stock including locomotives with a view to adopting the metric system of measurements. The various classes of locomotives

which will be dealt with by the Loco Wing have been outlined earlier (Chapter IV, para 4. 7. 2). It has also been stated that the Carriage & Wagon Wing of the Central Standards Office will be responsible for the modifications to drawings of standard types of wagons and coaching stock although a list of the types is not mentioned in this Report. Railways should, in due course, be advised of the types of wagons and carriages which will be dealt with by the Central Standards Office.

6. 1. 5 We have already suggested in Chapter IV that the Mechanical Department should aim at a total transition period of about 12 to 13 years so as to provide an adequate period of time for re-designing and production of spare parts on the metric system for standard types of rolling stock which will continue to remain in service beyond 1970. Consequently, it would not be necessary to undertake the examination of designs and drawings of rolling stock, particularly, the non-standard types, which will go out of use by 1970 and the railways may not thereby be loaded with any appreciable work in respect of alterations to designs and drawings of such stock.

6. 1. 6 The necessity of setting up a Mechanical Engineering Metric Cell in the Headquarters Organisation of Railways has already been brought out in Chapter III. While this Cell would be obviously essential during the preparatory phase, we are of the view that it may be found necessary at a later stage to retain a somewhat smaller organisation in the Headquarter Offices for the entire period of changeover, as unlike other departments, the problems in the Mechanical Branch will be of a considerably bigger magnitude. Besides the Headquarter Cells, the establishment of adequately staffed Planning Cells in all major workshops, would also be essential. These Planning Cells would be necessary for the entire period of the changeover. We propose to discuss in greater detail the functions and size of these Cells in subsequent paragraphs.

6. 2 The adoption of the metric system in the engineering industry would involve important changes of a basic nature which we now propose to discuss.

6. 2. 1 Screw Threads.

6. 2. 1. 1 In Railway Workshops, the British Association, British Standard Whitworth and British Standard Fine screw thread series are generally in use at present. It would be appreciated that no sudden or wholesale departure from the use of these threads in favour of metric threads on existing rolling stock and equipment would be possible. It may also be stated at the outset that there is absolutely no element of interchangeability between the existing and metric systems of screw threads. A gradual and planned substitution of the generally replaceable screwed components by the newly designed duplicates would, therefore, be necessary.

6. 2. 1. 2 The I. S. O. (International Organisation for Standardisation) has, for some years, been attempting to evolve an international system of screw threads with a view to combining the inch-based system and the Systeme International (metric threads in use on the Continent). So far an international agreement has been reached only for screw threads of pitch-diameter series below 6 mm diameter. The Indian Standards Institution after a study of the progress made in this direction, has decided to standardise the I. S. O. thread profile for all sizes. The Indian Standard : 886--1956 "Dimensions of Screw Threads below 6 millimetres", which is based on the draft ISO recommendation No. 84, is under publication and gives the dimensions for screw threads; bolts, nuts below

6 millimetres. With regard to the sizes above 6 millimetres, the standard is under preparation. The work of formulation of specifications giving details of materials, manufacture and other characteristics of the standard sizes of screws, bolts, nuts and other fasteners of different types would be taken up by the Indian Standards Institution in due course. A brief descriptive note on the new system of screw threads is given in Appendix VII.

6. 2. 1. 3 In order to permit the use of both British and metric system of screw threads during the transitional period, the Railway workshops will need to maintain facilities for producing both types of threads. In the conventional method, a screw cutting lathe can be adapted to cut either type of threads by change of train of gears—normally the replacement of the lead screw not being necessary. Another method merely involves the introduction of a gear in the train relative to the approximate ratio between the two systems.

It would be of interest to point out here that lathes are available which provide for cutting of screw threads on different systems, by means of a quick change gear box. In so far as whitworth and metric threads are concerned, the selection of various leads prevailing in the two systems can be made almost instantly on these lathes by positioning the relevant operating levers using the same lead screw. We may further add that such multipurpose screw cutting lathes are being produced indigenously and a few have been installed in Railway workshops.

6. 2. 2 The changeover to the new system will also involve a change in the gear tooth dimensions since the English pitches would be replaced by the module pitches. This should not, however, result in any difficulties in Railway workshops engaged in the maintenance of rolling stock, since the use of gear drives is extremely limited. Provision of some equipment capable of producing gears to both systems may, however, be necessary for the maintenance of machine tools. It is understood that multi-purpose gear cutting machines are obtainable for this purpose.

6. 2. 3 Raw materials to new sizes.

The adoption of new standards for raw materials would lead to important changes in respect of supplies received by Railway workshops. For the purpose of this study, raw materials may be divided into three categories:—

(a) Un-processed materials, such as foundry raw materials, blooms, billets etc.

It is obvious that the changeover will cause no difficulty and only the unit of accountal will by modified.

(b) Semi-processed materials, such as rolled steel sections, plates, bars etc.

We do not visualise any difficulty in this respect also as the planning sections in various workshops should make suitable selections from the new sizes after receipt of modified drawings and the new raw material standards. This will, of course, throw some additional load on the planning sections initially.

(c) Finished materials, such as bolts, nuts, rivets, screws, pins etc.

It will be appreciated that the Design Offices will be primarily concerned with the selection of the new sizes and the consumers should not, therefore, encounter any difficulty in this matter. It was suggested during the course of our investigations that it would be desirable to provide some distinctive markings on materials, such as bolts and nuts, finished to the metric sizes so as to prevent any confusion in the transition period. We are not in a position to make any concrete proposals in this direction but would suggest that this aspect should be kept in view while considering detailed measures for ensuring a smooth changeover in the transition period. Presumably the Indian Standards Institution will also consider this problem.

6. 2. 4 Machinery, Tools and Plant.

It might appear at first sight that the manufacture of duplicates in metric measures may require substantial replacement of, and major modifications to, the existing equipment. We, however, find that only minor alterations would be necessary to a few units of machinery and plant for their continued usage even after the changeover, as most of the equipment can be used for production in dual system without any modification whatsoever. For a general appreciation of the nature of necessary modifications to various types of equipment, we deal in the subsequent paragraphs with the machinery and plant normally installed in various sections of railway workshops :-

6. 2. 4. 1 Manufacturing Shops.

(a) Foundries—Iron & Brass. Cupolas, pit and tilting furnaces blowers and fans, sand mixing mills, moulding machines, drying ovens, tumbling, shot blasting and other fettling machines, ball breakers, etc.	No change.
(b) Forge-blacksmith, heat-treatment, welding shops. Steam and air hammers, drop stamps, presses (hydraulic, brake, trimming, etc.). Forging machines including spring buckling presses, hot and cold saws, shearing, punching and plate bending machines, spring cambering machines, scragging, load-deflection and chain testing machines, furnaces, ordinary and heat treatment, forges, air compressors, stationary boilers, electric and gas cutting and welding machines etc.	No change except for recalibration of various gauges and recording devices.
(c) Rolling Mill, Bolt & Nut Shops. Bolt, nut and rivet etc. forging machines, hot rolling mills etc.	No change in forging machines. New dies, punches would be necessary for redesigned bolts, nuts, rivets etc. worn rolls to be replaced or remachined, wherever possible, to roll metric sections.

(d) Sawmill, wood machine and pattern shops.

Log break down band mills, circular and band resaws, morticers and tenoners, planers, moulders, lathes, tensioning machines, saw and cutter grinders etc.	No change except for recalibration of thicknessing devices on band mills; use of modified cutters etc. to provide millimetre sizes. Patterns to millimetre sizes.

6.2.4.2 Finishing Shops.

(a) Machine and brass-finishing shops, tool room.

Lathes—automatic, capstan, turret, centre, combination etc.	No change except for provision, where required, of duplicate equipment for cutting metric threads; alteration of speed-feed tables; gradual replacement of dies, dieheads, drills, taps, chasers etc. to metric sizes. Screws actuating cross-traverse of tools, and scales may be replaced where necessary to give mm dial calibrations.
Relieving lathes.	Some new lathes to be provided to suit metric system.
Drilling and slot-drilling machines.	No change in machines. Only drills, reamers and taper sleeves to be changed to metric sizes gradually.
Planing, shaping, slotting, grinding (ordinary, radius link & hole, tool & cutter, centreless, etc.), milling machines etc.	No change except for scale or dial calibrations to mm sizes, where required. Milling cutters and form grinding wheels to mm sizes.
Screwing and tapping machines.	No change except for replacement of taps, dies, dieholders etc. to metric sizes.
Gear-cutting machines.	Dividing heads, gears, may require to be changed.
Boring and broaching machines.	No change except for replacement of broaches to mm sizes, where necessary.
Jig boring, die sinking, engraving machines, etc.	Necessary alterations to be carried out in consultation with manufacturers.
Miscellaneous—shafting motors traversers, cranes, hoists, jacks, capstans, reeling machines, etc.	No change.

b) Wheel Shop.

Wheel lathes, journal turning & grinding machines, quartering machines, centring, axle-turning machines, wheel presses, flaw detectors, sand blasting plants, ring burners & electric induction tyre heaters, etc.	No change in machines as such. Scales to be recalibrated, where necessary. Quartering machines crank pin screw cutting attachments to be changed in due course, to suit metric threads.

(c) Erecting, boiler, tender, Carriage & Wagon lifting and repair and paint shops.

These are omitted from detailed discussion being repair and assembly shops where hand tools are mainly used. The effect on tools etc. is considered in subsequent paragraphs. The following machines which have not so far, been covered are mentioned below:—

Boiler Shop: Tube descaling and flash butt welding machines.

No change will be necessary in these machines.

Paint Shop: Paint mixing machines, cone mills, coir testing machines.

No change is necessary in these machines.

6. 2. 4. 3 Miscellaneous Shops.

(a) Weighment Shed—Weighbridges and weighing machines may be recalibrated to read metric units in addition to the existing units.

(b) Whitemetalling, waste soaking and vacuum brake repair shop.—Only gauges etc. to be recalibrated.

(c) Millwright, copper & tinsmith shops etc.—Machinery and plant used here has mainly been covered in previous paragraphs.

(d) Fire stations & sprinkler installations —Except for recalibration of pressure gauges, capacities of fire extinguishers, tanks and other equipment to metric units, no other change may have to be made.

(e) Laboratory equipment in the Chemical and Metallurgical Laboratory attached to Railway Workshops will require recalibration, where necessary. No major changes are involved.

6. 2. 4. 4 It will be seen from the above analysis that in so far as machine tools and plant are concerned, the problems in adaptation are minor, as in the bulk of the manufacturing processes in repair workshops, the control on dimensions is externally applied and therefore, the machine tool itself, whether made to foot-pound or metric system is not affected by the change in system of measurement. The capacity or rating units will, of course, have to be revised. In this context the effect on small tools, measuring instruments and gauges, jigs and fixtures may also be considered.

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6. 2. 4.5 Effect on small tools.

Hammers, anvils, fullers, flatters, ferrules, tongs, callipers, dividers, face plates, marking table instruments.	No change. New purchases to metric sizes.
Bench vices, machine vices.	Do
Files, chisels, punches, drifts, swages etc.	Do
Screw drivers, spanners, scrappers, etc.	No change except for metric series sizes for new assets.
Pneumatic and electric small hand tools etc.	Do
Cutting tools for lathes, wheel lathes, shapers, planers, slotters, boring machines, wood working machines, etc.	Do
Milling cutters.	Do
Grinding wheels.	Do
Hacksaw blades, band saws.	Do
Drop stamps, press, forging machines and other dies, roll passes, etc.	Do
Taps, dies, drills, countersinks, reamers, morse taper sleeves, etc. form tools, form milling cutters, chasers, etc.	Gradual replacement to metric series of sizes for new assets.

6. 2. 4. 6 Effect on measuring instruments, gauges, etc.

Linear scales, verniers, micrometers, etc.	To be gradually replaced to mm. sizes (It may be pointed out here that a metric micrometer will have a much finer accuracy (0.01mm) against 0. 001 in. of the present.)
Snap & plug gauges.	To be gradually replaced to metric series for new assets.
Slip and feeler gauges, thread gauges of all types, gauge blocks, etc.	To be gradually replaced to new sizes.
Depth gauges, dial gauges and indicators, steam engine indicators, temperature recorders, etc.	Ranges to be recalibrated.

6. 2. 4. 7 Jigs and Fixtures.

Jigs and fixtures are required when parts are to be manufactured on a mass production basis. It has been indicated earlier that production on a dual basis in railway repair shops would be unavoidable during the transition phase and as such all existing jigs and fixtures will have to be retained. New jigs and fixtures would be needed for the production of metric designed components and assemblies. In the case of drilling jigs it may, however, be possible to use the same jigs by the provision of a separate set of bushes.

6. 2. 4. 8 We have attempted to analyse in the foregoing paragraphs the implications of the changeover in regard to machinery and plant, small tools, measuring instruments, gauges and jigs and fixtures. It will be generally appreciated that no serious difficulties will be encountered in relation to such assets, except that additional expenditure will be involved, particularly due to a substantial increase in the holdings of small tools, measuring instruments and jigs and fixtures. We find it extremely difficult to hazard even an approximate estimate of the additional expenditure to be incurred on this account, but we may draw attention to the results of a detailed analysis conducted in this connection by the National Physical Laboratory (Workshop Branch). It was estimated that the cost of the changeover to the metric system spread over a period of ten years for a general engineering workshop with equipment of the value of Rs. 50 lakhs would be in the region of Rs. 1. 8 lakhs i. e. 3.5 percent to 4 percent of the total investment in machinery, plant and other equipment.

6. 3 The Mechanical Branch Metric Cell in the Headquarters Office of the Railways will be entrusted with the main task of planning the complete details of the changeover in this Branch. While we appreciate that the Railway Board Metric Cell must necessarily formulate the general policy for the changeover, we may point out here that the important details of the various phases of the transition period in the Mechanical Department will need to be planned and evolved in the field. The Mechanical Cell in the Railway Headquarters Office would, through close association with the Workshops, be in a position to adopt the most suitable measures so as to ensure that there is a minimum set-back to production in workshops and to operation on line. We raised this issue during the course of discussion with the representatives of the Mechanical Department of all Railways and found considerable unanimity of opinion that the problems facing the Mechanical Department will need detailed study at the workshop level.

Some of the important functions of the Headquarters Cell are set out below:—

(a) Formulation of detailed instructions based on the policy directives received from the Railway Board Metric Cell.

(b) Arrangement for training of staff.

(c) Modification of designs and drawings of such non-standard equipment which would be retained in service after 1970.

(d) Revision of technical standing orders, maintenance orders, power standing orders, manuals etc.

(e) Formulation of the policy regarding phased substitution of existing replaceable spare parts and assemblies by metric designed duplicates.

(f) Planning the adaptation of machinery and plan in railway workshops to the extent considered necessarty.

(g) Estimation of the requirements of metric small tools, measuring instruments and gauges, etc. on a phased basis.

(h) Preparation of suitable instructions for Maintenance Depots (Running Sheds and Sick Lines) in regard to the stocking and use of spares on a dual system.

(i) Co-ordination with other Headquarter Cells, particularly Stores Cell, so as to ensure a uniform and smooth changeover in all branches of railway working. To ensure uniformity of execution of the changeover on all railways, it would equally be desirable to maintain close co-ordination with the Mechanical Cells of other railways.

6. 4 Workshop Planning Cells.

6. 4. 1 As pointed out earlier, the Mechanical Branch Metric Cell at Railway Headquarters, would formulate the broad outline of the policy in regard to the phased substitution, by metric designed components, of the existing replaceable duplicates on locomotives and other rolling stock. The detailed implications of such substitution of all replaceable parts would, however, have to be worked out in the workshops. This will involve detailed study which could only be carried out by a suitable organisation in workshops. We, therefore,recommend the establishment of Planning Cells in major workshops for this purpose and suggest that each such Cell shoud be placed under the overall charge of a Junior Scale Officer. These Cells would assist the local management in effecting a smooth changeover and as such would be generally guided by local Production Engineers.

6. 4. 2 The formidable problem of substitution of the replaceable duplicates by the metric designed components will have to be phased in regard to a very large number of parts and will include every threaded component. The repair capacity in railway workshops is insufficient to manufacture the total requirements of the metric designed replaceable components so as to be able to complete the substitution work in a short period. For instance, there are as many as 900 to 1100 water space stays on a locomotive boiler fire-box. These are examined and replaced to the extent necessary during periodical over-hauls. The number of stays to be replaced at each overhaul varies considerably, depending on the nature of repairs to be carried out. While it may, in theory, be considered desirable to replace all stays to metric size at time, to avoid confusion, particularly in Running Sheds, such a proposal could hardly be entertained on the grounds of economy and workshop capacity. A feasible solution may be to manufacture adequate stocks of water space stays of various metric step sizes for supply to workshops and Running Sheds and to procure sufficient quantities of metric reamers and taps, after which all replacements of water space stays should be carried out by metric size stays from a target date. We, however, feel that it will be necessary to examine this and other similar issues in considerable detail before adopting the most suitable procedure for the changeover.

6. 4. 3 To further illustrate the variations in the nature of problems which would arise in the change of assemblies to metric design, we may cite the examples of cylinder cover studs and crank pins. Cylinder covers are very often removed in Running Sheds for examination and change of rings with consequent damage to some of the studs. It would obviously not be advisable to replace only the damaged studs by the metric studs as this may result in wrong fitting of nuts. In such cases, the simultaneous replacement of all the cylinder cover studs would be unavoidable whenever it is decided to introduce the metric studs. Crank

pins normally last for a period of 9 to 12 years and are replaced only in workshops. Although there may not be any change in the size of the crank pin on account of redesign, the threaded portion will need to be modified to fall in line with the new system of screw threads. It would, therefore, perhaps be desirable to aim at the replacement of all inch-system crank pins by 1970. Such replacement would be possible on a phased programme basis only.

6. 4. 4 In addition to the main work of planning the phased substitution of components originally designed on the foot-pound system, the Planning Cells in major workshops would tackle the problem of selection of raw materials of new standards against particular Stores Orders. This aspect of the changeover could also be entrusted to the existing Planning Sections in the Production Offices, but since it would involve strengthening of the existing Planning Sections, it may be found preferable to allocate this work to the proposed Metric Planning Cells in the workshops.

6. 4. 5 Though it is not possible to estimate, even roughly, the number of duplicates which would require modification in design, and consequent manufacture on dual system during the transition period, we feel that the Production Offices would be burdened with considerable additional load for planning the manufacture of the metric design components. The strengthening of the organisation responsible for such work would, therefore, obviously be necessary.

6. 4. 6 The proposed Metric Cells in the Stores Branch of Railways discussed in Chapter X, would be required to ensure close and constant liason with the Workshop Planning Cells in order to introduce the progressive use of metric raw materials, semi-finished and finished supplies normally procured from outside sources. It would, therefore, be appreciated that the Planning Cells in the workshops would be called upon to offer constant guidance and assistance in connection with the above work. In fact, the work load on the Workshop Planning Cells in this connection, will be considerable and close cooperation between the proposed Cells in the Stores and Mechanical Branches would be necessary.

6. 4. 7 Since the replacement of such of the duplicates as will require to be redesigned to metric measurements would naturally be spread over a long period of time, it will be necessary to issue suitable instructions to Running Sheds and Sick Lines from time to time. Whereas the policy directives in respect of such replacements would necessarily issue from the office of the Chief Mechanical Engineer, we visualise that the major workshops would prepare suitable detailed instructions and issue them in free quantity to the Maintenance Depots. We would like to add a word of caution at this stage that these instructions should be very explicit and Maintenance Depots should nominate only experienced supervisors for checking this work to ensure full compliance.

6. 4. 8 We have explained earlier in this chapter that it would be necessary to plan the adaptation of machinery and plant as also to prepare estimates for the additional requirements of metric small tools and metric measuring instruments. The Planning Cells in the workshops should work out the details for the various shops.

6. 4. 9 It has been indicated earlier that workshops would not experience any difficulties or require many additional supervisors for the purpose of training of various categories of workshop staff as senior supervisor-trainees could preferably be utilised for this purpose during working hours. It would, however, be necessary to arrange for the training of all categories of staff before the end of the preparatory stage and we

would suggest that the Planning Cells with the workshops should work out the detailed programme for such training. Incidentally, one roving Intructor per division would be required for a period of 1-2 years for the training of staff in the smaller Maintenance Depots (Running Sheds and Sick Lines).

6. 4. 10 The important functions of the proposed Planning Cells in the workshops, as enumerated above, would indicate that it would be essential to provide adequate staff for this purpose. Our discussions with the representatives of the Mechanical Department of the Railways have revealed the necessity of having a Junior Scale Officer assisted by a Senior Foreman and other staff to man each of these Cells. Besides the additional staff in the main offices of the major workshops, provision will also have to be made for additional staff in the Jig and Tool Drawing Offices, Tool Rooms and the Inspection Sections.

6. 5 A reference has already been made to the additional work load in regard to modification of designs and drawings, mainly of such non-standard equipment and rolling stock which will remain in use after 1970. The main drawing offices of the Mechanical Department on most railways, are located in the major workshops. It will, as such, be appreciated that the main responsibility for modification of designs and drawings would devolve on the workshop drawing offices, which will carry out this work under the guidance of the local management. It would hence be useful to provide for a considerable measure of association between the proposed Planning Cells and the workshop drawing offices.

We have observed wide disparity in the estimates of railways in regard to the number of drawings which would require modification. It was found that many railways were planning to undertake modification work even on drawings of standard rolling stock. In view of what has been stated in chapter IV, the additional work-load on the drawing offices of the Mechanical Branch of railways, would not be very heavy. We, however, visualise that railways would be called upon to modify a fairly large number of non-standard equipment, varying from 10,000 to 15,000 drawings per railway. It has been roughly estimated that one Drawing Office Superintendent (class II), one Chief Draftsman, 2 Head Draftsmen, 5 Senior Draftsmen, 8 Junior Draftsmen and 10 Tracers along with other adequate office staff per railway would be required for a period of about 3-5 years.

6. 6 We have outlined above the main functions of the Headquarters Metric Cell and the Workshop Planning Cell in the Mechanical Branch. It is obviously not possible, at this stage, to list all items of work which would require their attention in connection with the changeover. We now propose to briefly discuss some of the important miscellaneous features which would require attention as a result of this changeover:—

(a) It would obviously be necessary to alter the markings of tare weight, carrying capacity, floor area, etc. to the metric units on all rolling stock. For reasons outlined in Chapter XI, the Commercial Branch is likely to effect a complete changeover to the metric units on and from 1-4-60, and markings in both existing and metric units during periodical overhaul of goods stock should, therefore, commence immediately. This dual marking would be necessary up to the date of changeover in the Commercial Department and we recommend that the railways should be advised immediately to start this work. Of the other important units, which would need recalibration are—locomotive tenders, travelling cranes, pressure and vacuum gauges, speedometers, temperature recording instruments, weighing machines, weigh-bridges, etc.

(b) In railway workshops various practices adopted, particularly with regard to clearances, play, valve setting etc. in fitting of components of the diverse type of locomotives and other rolling stock are not always codified and knowledge of these practices has been handed over, more or less, by tradition. With the change in the unit of linear measurement, the staff must reorient their ideas of *'sut'*, *'bal'* and *'hawa'* and it would, therefore, appear very desirable to attempt a suitable codification of such workshop practices and eliminate the possibility of any confusion in the future.

(c) Adaptation of some of the equipment, revision of analysis and test forms and any other works in connection with the changes in the shop practices, where required, would have to be carried out in the Chemical & Metallurgical Laboratories attached to major workshops.

6. 7 Ferry Steamer and Harbour Services.

We do not anticipate any special problems in regard to the effect of the changeover on the Railway-managed ferry steamers and their operation and maintenance facilities. The assets of this department are controlled by the Mechanical Branch and generally action, as applicable, to other mechanical engineering assets and railway repair workshop would also be necessary in this field. The over-all cost of the changeover on the North-Eastern, Southern and other Railways running these Services would, therefore, increase slightly on this account.

6. 8 Interchange with Pakistan.

6. 8. 1 Fears were expressed during the course of discussion with the representatives of a Railway that any major modifications in the design of replaceable components may lead to difficulties in the routine maintenance of wagon stock which is normally interchangeable with the Pakistan Railways..

6. 8. 2 We do not visualise that there would be any radical change in the design of most of the components of our standard types of wagons and, as such, the adoption of the metric system on Indian Railways may merely lead to additional work of stocking of some more non-standard components at a few of the major depots in the two countries.

6. 8. 3 The adoption of the metric system, however, will necessitate consultations with the representatives of the Pakistan Railways with a view to suitably modifying the rules for interchange of traffic.

6. 9 Phasing of the changeover.

Our recommendations have been based, generally, on the assumption that it would be feasible to effect, a more or less, complete changeover by 1970.

We cannot help repeating our doubts regarding the availability in time of the additional designers and draftsmen for completing the modifications of designs and drawings during the preparatory phase which will close in 1962. Furthermore in the absence of the availability of the metric tools and measuring instruments in the immediate future it may also be difficult to acquaint and train a large body of men in the mechanical workshops in the new system of measurements within the scheduled period of time. Similarly, it may not be found practical to replace completely, such of the components of various standard types of rolling stock as would have to be redesigned and manufactured on the metric basis by 1970. The completion of the changeover in the Mechanical Branch will, therefore, be dependent on numerous conditions which may not be fulfilled according to the proposed schedules and the ultimate changeover may, therefore, take a little longer.

The important features of the phased action are summarised below :—

6. 9. 1 Preparatory phase—5 years (1957-1962).

(a) Setting up of the Mechanical Department Metric Cell in Railway Headquarters—June 1957.

(b) Dual markings on goods stock—to commence immediately.

(c) Arrangements for recruitment and training of drawing office staff—to commence immediately.

(d) Procurement of metric measuring equipment, gauges, small tools, etc. on a gradually increasing scale—to commence as early as possible.

(e) Gradual recalibration of weighbridges, weighing machines, locomotive tenders, cranes, pressure and vacuum gauges etc.—to commence before December 1957.

(f) Setting up of Planning Cells in major workshops—June 1958.

(g) Modifications to designs and drawings, where necessary—June 1958 onward.

(h) Revision of technical standing orders, local manuals and rule books etc—to commence by June 1958.

(i) Gradual revision of raw material schedules, planning cards, etc—to commence by June 1958.

(j) Creation of training facilities—by December 1958.

(k) Gradual adaptation of machinery and plant to the extent necessary—to commence by December 1958.

(l) Gradual manufacture of some of the redesigned components in railway repair shops—to commence by January 1960.

(m) Changeover to the metric units in coal accountal—from 1-4-60.

6. 9. 2 Transitional phase—8 years (1962-1970).

(a) New rolling stock, machine tools, plant and other equipment to be obtained to metric design only—April 1962. (It would, however, be desirable to commence this earlier, if possible.)

(b) Gradual elimination of the manufacture of components on the foot -pound system.

6. 10 Financial Implications.

It is, at this stage, extremely difficult to prepare an accurate estimate of the cost of changeover. There is considerable variation in the estimates submitted by the railways. We have examined the requirements of additional staff and equipment as put forward by the zonal railways and have attempted to give below an approximate estimate of the cost of changeover in the Mechanical Branch of a railway system :—

Items of work	Estimated average cost per railway
(a) Mechanical Department Metric Cell at Railway Headquarters.	Included in chapter III.
(b) Planning Cell at each major workshop on the railway, for about 5 years, consisting of the following staff.*	** Rs. 10 lakhs.
(i) Production office: One Junior Scale Officer, one Planning Superintendent, one Assistant Planning Superintendent, 2 Chargemen, 2 Planners, 1 Senior Draftsman (Jig and Tool), 2 Junior Draftsmen, 3 Tracers and adequate office staff.	
(ii) Tool Room: One Assistant Foreman, one Chargeman, 3 highly skilled Fitters and other skilled, semi-skilled and unskilled Tool Room staff according to requirements.	
(iii) Inspection Section: One Assistant Foreman and one Chargeman.	

(* These figures should be treated as very rough estimates only of the approximate requirements of staff for a major workshop of the size of Jamalpur).

(** This figure has been arrived at on the basis of 2 major workshops per railway. The actual allotment for each individual railway will depend on the number and size of its workshops).

(c) Modification of designs and drawings.	Rs. 5 lakhs.
(d) Adaptation of machinery and plant including recalibration of weighing machines, weighbridges, etc. Procurement of additional small tools, measuring instruments, gauges etc. to metric system and additional jigs and fixtures.	Rs. 20 to 25 lakhs.
(e) Training facilities.	Rs. 0. 75 lakhs.
	Total Rs. 38 lakhs per railway i. e. Rs. 266 lakhs for all railways.

CHAPTER VII.

PRODUCTION UNITS.

7. 1 The implications of the changeover to the metric system of weights and measures in regard to repair workshops and Running Maintenance Depots of the Mechanical Branch have been dealt with in the last chapter. We now propose to outline the important problems that will arise in the production units of the Mechanical Branch, viz. the Chittaranjan Locomotive Works and the Integral Coach Factory, Perambur.

7. 2 Chittaranjan Locomotive Works.

7. 2. 1 It will be appreciated that being similar in some respects to railway repair workshops, the important steps, as outlined in the last chapter, would be equally necessary for the changeover in these Works. Provided that adequate preparatory measures, such as the issue of new Indian Standards by the Indian Standards Institution, supply of new designs and drawings by the Central Standards Office, supply of raw materials, small tools and measuring instruments etc. to new standards are initiated by the interests concerned, we do not visualise any great difficulty in bringing about the change over in these Works.

7. 2. 2 It would be necessary to set up a Metric Planning Cell and we recommend that a suitable organisation be set up for a period of 2—3 years to deal with the important problems arising from the changeover. These are dealt with in the subsequent paragraphs.

7. 2. 2. 1 It would be desirable to commence rough preplanning of planning sheets, alterations to feed and speed charts etc. almost immediately after receipt of instructions regarding the introduction of the metric system. It may, however, be added here that the rough preplanning work can be initiated only after the receipt of the new standards of raw materials.

7. 2. 2. 2 Unlike railway repair shops where the extent of adaptation of the machinery and plant will be of a very limited nature, we found that it would be necessary to undertake this work on a large number of machine tools at Chittaranjan Locomotive Works. This would be necessary on account of the recent introduction of scientific and modern rate fixing methods based on the full use of calibrated scales and other dials affixed on machine tools. Our discussion with the representatives of Chittaranjan Locomotive Works revealed the necessity of ascertaining from the manufacturers of machine tools and equipment, the nature and quantum of work involved in such modifications. Chittaranjan Locomotive Works were therefore requested to obtain the necessary information by direct reference to suppliers. We may add here that a part of the work of modifications could be carried out locally, with out outside assistance. However, a decision on this matter can only be taken after receipt of the detailed information from the manufacturers and we do not propose to make any concrete recommendation at this stage. other railway workshops may, with advantage, await the results of the investigation of the Chittaranjan Locomotive Works.

7. 2. 2. 3 It would be necessary to commence the examination of jigs and fixtures soon after the receipt of modified part drawings so as to ascertain the nature and extent of modifications required on

them. We are of the view that it would not be necessary to maintain a duplicate set of jigs and fixtures for any length of time, and that a number of fixtures and some of the drilling jigs could be made use of after minor alterations. It is, however, difficult even to roughly assess the work load in regard to modifications of jigs and fixtures and we, therefore, hesitate to suggest a target date for the complete modifications.

7. 2. 2. 4 We have not received any indication from the trade and industry about the likely date of availability of the metric small tools, measuring instruments, gauges etc., but the complete changeover to the metric system, as stipulated in the Act within a period of ten years would be feasible only if these items become available latest from 1958-59 onward. The proposed Planning Cell should, however, prepare estimates of requirements of metric small tools, measuring instruments, gauges etc. at an early date so that procurement on a gradually increasing scale could be arranged. Some of the tools and gauges are manufactured in these Works and, as such, their tool room will be loaded with additional work for a period of 2-3 years and some additional staff for this purpose may have to be appointed.

7. 2. 2. 5 The preparation of new raw-material schedules can only be undertaken after the receipt of modified drawings from the Central Standards Office. It would, however, be desirable that the proposed Planning Cell should initiate action soon after the receipt of the first batch of modified drawings from the Central Standards Office, so that the work may commence gradually and be completed in a reasonable period of time.

7. 2. 2. 6 We accept that no elaborate training arrangements would be necessary for the staff of Chittaranjan Locomotive Works in order to acquaint them with the new system of weights and measures, the proposed Planning Cell should, all the same, lay down the general lines of the training arrangements which may be found necessary in this connection.

7. 2. 2. 7 It would be readily accepted that unlike the repair workshops on railways, the total period of transition at Chittaranjan Locomotive Works will be comparatively short. It may, therefore, be suggested that this unit should commence production of locomotives to metric measures only after all part drawings requiring modifications have been suitably altered. While this would minimise the difficulties of Chittaranjan Locomotive Works, such a line of action would throw additional load on repair workshops, as they would be called upon at a later stage to replace the foot-pound system components by metric design duplicates. We would, therefore, recommend that the Chittaranjan Locomotive Works should consider the commencement of production of each metric assembly as and when its modified drawings are received from the Central Standards Office and not await the receipt of the complete set of modified drawings for the entire locomotive.

7. 2. 3 During the transition period there will be a gradual increase in work in the Stores Depot of the Chittaranjan Locomotive Works. This will be mainly in regard to revision of price lists, ledger cards, accountal and issue of materials and duplicate stocking of re-designed locomotive parts, small tools and measuring instruments. In our opinion the transition phase should last for a period of about 3-4 years (1957-61). It will, therefore, be necessary to provide additional stores staff during the period of transition.

7. 2. 4. Phasing of the changeover.

Since its inception this production unit has manufactured only WG class of locomotives. We learn that the pending orders for this class of locomotive will fully utilise the capacity for another 2-3 years. We have stated earlier that it would help to reduce the transitional difficulties of railway repair shops if Chittaranjan Locomotive Works could go over to the production of metric design components as early as feasible. Since it is difficult at this stage to forecast even approximately the likely stage of availability of the modified drawings, metric small tools and measuring instruments etc., we may, assume that the pending orders for WG locomotives will be completed on the foot-pound system.

An order for a limited number of WT and WP locomotives has also been placed and their production is likely to commence early. In regard to the production of these locomotives we would suggest that the possibility of undertaking their manufacture on metric basis should be examined.

The phased action in regard to the changeover is summarised below :—

(a) Setting up of Planning Cell—June, 1957.

(b) Adaptation of machinery and plant action to be initiated by June, 1957.

(c) Gradual planning and procurement of raw material to new standards—January, 1958 onward.

(d) Preparation of estimates and gradual procurement of metric small tools, measuring instruments, gauges etc—to commence as early as possible.

(e) Examination of jigs and fixtures with a view to effecting necessary modifications—January, 1958 onward.

(f) Training arrangements for staff—to commence by January, 1958.

(g) Progressive manufacture of various assemblies to metric measurements—to be initiated by January, 1959.

7. 2.5 Financial Implications.

The approximate estimated cost of changeover at Chittaranjan Locomotive Works, as estimated at present, is summarised below :—

Item of work		Estimated cost
(a) Planning Cell consisting of one Senior Foreman, one Senior Draftsman, two Junior Draftsmen & one planner for a period of 2-3 years.	Rs.	40,000
(b) Training of staff.	Rs.	5,000
(c) Adaptation of machine tools, jigs and fixtures and provision of additional small tools, measuring instruments, gauges etc.	Rs.	10,00,000
(d) Additional Stores staff.	Rs.	30,000
Total...	Rs.	10,75,000

7. 3 Integral Coach Factory, Perambur.

7. 3. 1 It would be recalled that this Factory has been set up in collaboration with a Swiss firm which normally work to the metric system of weights and measures. The consultants had, therefore, to adopt the foot-pound system while planning the plant and machinery as also in working out the design of the integral coach to be produced in this Factory. A substantial portion of the machinery and plant installed in this unit was obtained from countries in the Continent which work on the metric basis. The recalibration of the equipment at the Integral Coach Factory should not, in our opinion, present much difficulties.

7. 3. 2 The setting up of a Planning Cell for a period of about one year for working out the details of the changeover will, however, also be necessary for this Factory and we recommend that the Cell should be set up early. The main functions of the Cell would be almost identical to those enumerated in regard to the proposed Planning Cell to be set up at the Chittaranjan Locomotive Works.

7. 3. 3 The Central Standards Office will not be called upon to make any modifications of designs of the intergal coaches, as all design and drawing work in respect of these coaches is carried out at the Integral Coach Factory. The Integral Coach Factory drawing office would, therefore, need to be strengthened. The additional requirement of draftsmen has been estimated in the region of 4 high grade Draftsmen, 8 Junior Draftsmen and 10 Tracers. It is expected that the work of modifications to designs and drawings, including those in connection with jigs and fixtures would be completed in 12 to 18 months. It will be appreciated that the main burden of changeover in regard to modification of designs and drawings will fall on the Jig and Tool Section of the Drawing Office as almost all components, sub-assemblies and assemblies are mass produced with the help of jigs and fixtures in this unit. It may also be pointed out here that most of the jigs and fixtures will require to be duplicated as there would be period of overlap of about 18 months, during which simultaneous production of components on the foot-pound and the metric system would be unavoidable.

7. 3. 4 Our discussion with the representatives of the Integral Coach Factory revealed that materials were normally ordered two years in advance of the commencement of work against a particular batch of coaches. The Factory has already placed orders for materials against the 6th and 7th batches while for the 8th and 9th batches the orders are to be placed by September 1957. We were further informed that they were planning to place orders for materials for the 10th and 11th batches by November 1958 and supplies were expected to commence towards the beginning of 1960. It was, therefore, generally accepted that production of coaches to the metric design could commence from the 10th and 11th batches since the Integral Coach Factory would require approximately 18 months for the redesigning of coaches, alterations to the jigs and fixtures etc. after receipt of final orders from the Board. We, therefore, recommend that production of metric integral design coaches should commence with the 10th and 11th batches.

7. 3. 5 The Integral Coach Factory is at present producing Third Class shells only. We were informed that a design for a Third, Luggage and Brake would soon be finalised, but no concrete action has yet been initiated for the design of other types of integral coaches. While it will not be desirable to postpone the finalisation of the design for the Third, Luggage and Brake, it may be considered necessary to undertake the

preparation of designs of other types only when the metric standards become available. We would, therefore, suggest that this aspect be kept in view and the designs for other types should preferably be prepared to metric standards only.

7. 3. 6 Strengthening of the Stores organisation in the Integral Coach Factory will be found necessary to deal with the additional work arising out of this changeover.

7. 3. 7 Phasing of the changeover.

The transitional period will be comparatively short, but co-existence of the two systems would be unavoidable during the stage where the first coach series to the manufactured to metric dimensions overlaps the last series manufactured in the present system. The sequence of important aspects of the phasing would be as follows :—

(a) Setting up of Planning Cell—June, 1957.

(b) Redesigning of standar coaches, modifications to jigs and fixtures etc.—to commence from June, 1957.

(c) Preparation of estimates and gradual procurement of metric small tools, measuring instruments and gauges etc.—to commence as early as possible.

(d) Preparation of material schedules to new standards—to be completed by October, 1958.

(e) Gradual adaptation of machine tools and plant and manufacture of additional jigs and fixtures - to commence by January, 1959.

(f) Production of coaches to metric design—sometime between April, 1961 and March, 1962.

7. 3. 8 Financial Implications.

The approximate estimated cost of the changeover in the Integral Coach Factory is as follows :—

	Items of work.		Estimated cost.
(a)	Planning Cell for 1 year.	Rs.	50,000
(b)	Preparation of new designs, including those of jigs and fixtures.	Rs.	70,000
(c)	Adaptation of machines and equipment, manufacture of duplicate jigs and fixtures and procurement of additional measuring instruments, small tools, gauges etc.	Rs.	10,00,000
(d)	Additional Stores Staff.	Rs.	30,000
	Total. .	Rs.	11,50,000

7. 4 Besides the two production units dealt with above, the Board have recently sanctioned the setting up of a Furnishing Unit at Perambur. They have also under consideration proposals for the establishment of a Metre Gauge Integral Coach Factory and a Duplicates Factory for the production of spare parts of standard locomotives. We recommend that all these new units should be planned on the metric basis and manufacture metric design components from the commencement of production. We wish, however, to add that interim arrangements of a temporary nature are also being made at Perambur for the furnishing of Integral Coach Factory shells until the permanent Furnishing Unit is established. It would, therefore, be necessary to carry out the furnishing work during the interim period mainly on the foot-pound system.

CHAPTER VIII.

SIGNAL & TELE-COMMUNICATION ENGINEERING BRANCH.

8.1 General.

8.1.1 This chapter should be read in conjuction with the previous chapters, particularly Chapter IV, wherein we have indicated the nature of action to be taken by the Signal & Tele-Communication Wing of the Central Standards Office. It will be appreciated that this Branch can only commence action when basic data such as "adequate distance", distances between signals, location of signals *vis-a-vis* points etc. as given in the General Rules and Schedule of Dimensions relevant to this Branch are revised and metric standards laid down. We would, therefore, suggest that the Traffic and the Signalling Branches of the Railway Board's Office should examine this issue in the immediate future in order to enable the Railways to initiate action.

8.1.2 As in the case of the other Engineering Departments, the modifications of designs and drawings of standard signalling equipment will be carried out by the Signal & Tele-Communication Wing of the Central Standards Office. The Railways will, therefore, be primarily concerned with the changes to such of the non-standard signalling equipment which is expected to remain in service beyond 1970. It may be stated at the outset, that the work load in this connection will be of a limited nature and the Signal Engineering Branch on the Railways will not be called upon to undertake re-design work on a large scale.

8.1.3 The creation of the Headquarters Signal & Tele-Communication Metric Cell on each Railway, has already been recommended in Chapter III. This Cell will direct and co-ordinate the changeover in the Signalling Branch. Its basic functions will be, more or less, similar to those of the cells for the Civil and Mechanical Engineering Branches, which have been detailed in Chapters V and VI. We do not, therefore, propose to discuss them again in this Chapter.

8.2 Signalling Equipment and Plans.

8.2.1 It would be pertinent to point out that unlike the fairly high degree of standardisation already achieved in the Mechanical and Civil Engineering Branches of the Railways, the process of standardisation in regard to signalling equipment, was initiated comparatively recently and although considerable progress has been made in this direction, a substantial portion of the signalling equipment on some Railways continue to be of non-standard designs. We learnt from the Railways that they had been asked to introduce, if possible, the recently standardised parts even on non-standard mechanical signalling equipment, whenever replacement became necessary. We, however, found considerable divergence of views in regard to the possibility of the implementation of this directive. All Railways agreed that it was desirable to eliminate, as far as possible, the manufacture and procurement of non-standard parts for the existing equipment and that they were making efforts in this direction. It was emphasised by some Railways that the non-standard signalling equipment on a large number of stations will continue to remain in service even after 1970, and that procurement of some non-standard components for replacement purposes would be inescapable.

8.2.2 In regard to the electrical signalling equipment, which has been introduced on a small scale on some railways in recent years only, we understood that the adoption of the metric system would not raise any problems. It would obviously be necessary to plan our future installations of electrical signalling equipment on the metric basis.

8.2.3 Besides the modifications to designs and drawings of mechanical signalling equipment, the railways will be called upon to examine the changes to be carried out to station working rule diagrams, interlocking plans, cable and wiring diagrams etc. With regard to the station working rule diagrams, it would only be necessary to indicate the metric equivalents of the salient dimensions as these plans are not normally drawn to scale. While duplicate dimensions would be necessary during the preparatory phase, we would suggest that station working rule diagrams to be prepared after 1961-62 should show metric dimensions only.

The interlocking plans are usually drawn to two different scales—one for the longitudinal and the other for the transverse direction. We understand that these plans are necessary for periodical testing of interlocking gear and for an important record. It would, therefore, be necessary to redraw the interlocking plans on the metric basis as soon as the Schedule of Dimensions and the relevant signalling data of the General Rules have been revised. In regard to wiring and cable diagrams, it would suffice if metric equivalents of main dimensions are shown thereon.

8. 2. 4 It is estimated that on an average there are about 3,000 to 4,000 drawings and plans per railway which, may require attention outlined in the foregoing paragraphs. The additional requirement of draftsmen and tracers for this purpose, has been placed in the region of 1 Senior Draftsman, 3 Junior Draftsmen and 4 Tracers per railway for a period of about 2 to 3 years.

8. 3 Machinery & Equipment.

The Signalling workshops of Railways undertake the repair and manufacture of mechanical signalling equipment. It will be appreciated that these workshops are more or less similar to Mechanical workshops in regard to equipment though the overall assets are comparatively very small. The implications of the impact of the changeover on the Signalling workshops in regard to adaptation of machinery and plant, supply of small tools and measuring instruments etc., would, therefore, be of a minor nature and we do not propose to discuss them here. It would obviously be desirable to commence manufacture of signalling gear such as lever frames, cranks, compensators etc., redesigned to the metric system as early as feasible.

8. 4 The metric units are already largely in use in the specifications for Tele-Communication and Wireless equipment. The Railways shared our view that the changeover to the metric system will not raise any problems in this sphere. The changes, if and when necessary, should be affected in co-ordination with the sister branches of the Post & Telegraph Department.

8. 5 Training of Staff.

It would be necessary to arrange for supply of conversion tables, charts and data for the staff of this Branch. The supervisors should, in most cases, be able to impart the elementary training to some of their staff at the main centres. It would, therefore, be necessary to provide 2 or 3 roving Instructors for a period of about 1 year to undertake the training of staff distributed at numerous points on the line on Divisions. An Inspector for a period of about 6 months may also be required for the major Signalling workshop.

8. 6 Phasing of the changeover.

We are of the view that the changeover in this Branch can be effected completely in a comparatively shorter period. It would, however, be desirable to plan a uniform preparatory phase for most of the engineering departments and we, therefore, suggest that the preparatory phase in this Branch should also last till 1962. The transitional and the final phase could be combined into a period of about 3 to 4 years after 1962. Manufacture and procurement of mechanical signalling equipment on the dual basis is, therefore, likely to prevail during the period 1960-1966. The details of the phasing are shown in the subsequent paragraphs.

8. 6. 1 Preparatory phase—5 years (1957-1962).

(a) Setting up of the Signal & Tele-Communication Metric Cell in Railway Headquarter Offices—June, 1958.
(b) Estimation and procurement of metric measuring equipment—to commence as early as possible.
(c) Revision of drawings, plans, specifications etc.—to commence by June, 1958.
(d) Creation of training facilities—by December, 1958.

8. 6. 2 transitional phase—3-4 years (1962—1966).

Both the current and metric units will co-exist with progressive emphasis on metric units. Machine tools, small tools, measuring instruments and signalling equipment etc. will be indented to metric specifications only. All foot-pound system units will be gradually eliminated.

8. 7 Financial Implications.

The financial implications of the change spread over a period of about 8 years for the Signal & Tele-Communication Engineering Branch of a railway system based on the present estimates, are indicated below:—

	Items of work	Estimated average cost per Railway.
(a)	Signal & Tele-Communication Engg. Department Metric Cell at Railway Headquarters.	(Included in Chapter III)
(b)	Procurement of metric weights and measuring instruments and gradual adaptation of machinery and equipment to metric system.	Rs. 20,000
(c)	Training of staff.	Rs. 15,000
(d)	Revision of signalling plans and drawings etc.	Rs. 80,000
	Total : per Railway.	Rs. 1,15,000

Total : i. e., Rs. 8 lakhs for all Railways.

CHAPTER IX.

ELECTRICAL ENGINEERING BRANCH

9.1 General.

9.1.1 The general preparatory steps, as also the action common to the other engineering branches of railways, outlined in the earlier chapters will form preliminary essentials for the changeover in the Railways' Electrical Branch. We may, however, state at the very outset that compared to the Civil and Mechanical Engineering Branches, the workload in the Electrical Department will be comparatively smaller and no serious difficulties are likely to be encountered in implementing the reform in this field. It will be appreciated that the metric system units are already largely in use in electrical engineering. The electrical units and quantities such as amperes, volts, watts, etc , are internationally used and their multiples are also based on the decimal system.

9.1.2 The major portion of the requirements of spares for the operation and maintenance of stationery and mobile electrical equipment on the railways are obtained from trade and manufacture on railways is confined mainly to mechanical duplicates. The effect of the changeover to the metric system with regard to the production of the mechanical spares would be almost identical to the problems of the Mechanical Department, which have been discussed earlier in Chapter VI. So far as the electrical spares are concerned, the Railway Electrical Department would naturally follow the trade and industry and would be dependent on them for procurement of metric size spares. We were informed that it may become necessary to stock-pile a few essential replaceable electrical components so as to last the useful life of the existing major assets as the trade was not likely to continue manufacture of such spare parts in the foot-pound system for any length of time. Estimates of requirements of such articles will have to be carefully worked out by the Electrical Branch of Railways so that adequate replacement stocks would be available for the maintenance of existing major assets without in any way resulting in unnecessary overstocking.

9.1.3 It has been recommended earlier in Chapter III that a Metric Cell should be set up in the Electrical Department at the Headquarters Office of each zonal railway. The proposed Cell will be responsible for directing and co-ordinating the changeover to the metric system in this Branch. The important functions of this Cell would be more or less, similar to those of the other engineering cells in the Headquarter Offices. Briefly they will relate to the arrangements for training of staff, modifications to designs, drawings and manuals, preparation of estimates for metric tools and measuring instruments and revision of specifications for electrical stores, machinery, plant etc.

9.2 The main functions of the Electrical Department on the railways are in respect of generation, transmission, distribution, train lighting, traction, etc. We do not visualise that there would be any major difficulties in any of these fields and the problems will mainly relate to the progressive use of metric units of measurements. It would obviously be necessary to gradually recalibrate pressure and vacuum gauges, temperature recorders, steam flow gauges etc. It may be desirable to maintain duplicate markings on these instruments for some time and conversion of the design and performance data may not, therefore, be necessary. We also understood from a few Railways that there would not, even be, any difficulty in undertaking such conversion, if required. The Railways were generally of the view that the traction and train lighting equipment would not be seriously affected by the proposed changeover whereas necessary modifications to the designs of the mechanical portions of such equipment could be carried out. It may also be pointed out here that the gantry posts mileage number plates on electrified sections would require replacement to indicate distances in kilometres.

We have already indicated our views in the matter of planning of new projects to the metric system in Chapter V on Civil Engineering Branch. It may be stated that large scale electrification of railways is under contemplation in the period of the Second Plan. We recommend that such of the electrification projects as are likely to be taken in hand after 1960, should be planned on the metric basis.

9. 3 Designs and Drawings.

It has been brought out earlier in Chapter IV that in the absence of an Electrical Wing in the Central Standards Office, all the work load in respect of modifications to designs and drawings would be borne by the railways. Our investigations reveal that the Railways with electrified sections would be required to modify about 10,000 drawings including drawings prepared and maintained in Divisions and Districts. The other Railways would be called upon to undertake modifications to about 5,000 to 6,000 drawings only. The above figures are inclusive of part and assembly drawings, transmission line drawings, distribution system drawings, block plans, etc. We, therefore, estimate that additional staff consisting of about 4 Senior Draftsmen, 6 Junior Draftsmen and 10 Tracers would be required for a period of 2 to 3 years for a zonal railway with electrified sections and provision of about 2 Senior Draftsmen, 3 Junior Draftsmen and 5 Tracers per zone would be adequate for the other Railways for a period of 2 to 3 years.

9. 4 Machinery and Plant.

We have already discussed the effects of the changeover on machinery and plant in detail in Chapter VI on Mechanical Engineering. Similar action would be required in regard to the maintenance and repair workshops of the Electrical Branch.

9. 5 Training of Staff.

The supervisory staff should find no difficulty in familiarising themselves with the metric units of weights and measures. As in the case of other departments, it would, however, be necessary to make special arrangements for the training of unskilled, semi-skilled and skilled staff in the Electrical workshops and on the open line. We generally agree with the views of most of the Railways that provision should be made for roving Instructors for the staff on line and that major Electrical workshops should also be provided with an Instructor for this purpose. We visualise that about 3 roving Instructors and one Workshop Instructor would be required for about one year to impart the necessary training.

9. 6 Phasing of Changeover.

As in the case of the other engineering branches, the two systems will co-exist for a few years, particularly in the Electrical workshops. In the case of out-station installations, overhead line equipment, house wiring, circuit breakers, high tension switch gear etc., the usual renewals could be carried out with metric design units as soon as supplies from trade became available. The complete changeover in the Electrical Department could be effected in about 6 to 8 years period and the important details of the phasing are outlined below:—

9. 6. 1 Preparatory Phase—5 years (1957—1962).

- (a) Setting up of the Electrical Department Metric Cell in Railway Headquarter Offices—June, 1958.
- (b) Estimation and procurement of metric measuring equipment—to commence as early as possible.
- (c) Creation of training facilities—by December, 1958
- (d) Modifications to designs, drawings, local manuals and codes, etc.—to commence from June, 1958.
- (e) Adaptation of machinery and plant—to commence from January 1959.
- (f) Execution of Electrification projects on metric basis entirely—April, 1960 onward.

9. 6. 2 Transitional Phase—3 years (1962-1965)

- (a) Planning and indenting of new equipment to metric designs only—to commence as early as feasible.
- (b) Gradual elimination of the usage of foot-pound system.

9. 7 Financial Implications.

The financial implications of the change, spread-over a period of about 6 to 8 years, for the Electrical Engineering Branch of a railway system are given below. We may emphasise here that these are only approximate estimates.

Items of work	Estimated average cost per railway.
(a) Electrical Department Metric Cel lat Railway Headquarters	(Included in Chapter III.)
(b) Procurement of metric weights and measuring instruments, gradual adaptation of machinery and equipment to metric system.	Rs. 80,000
(c) Training of staff.	Rs. 20,000
(d) Revision of drawings and plans, etc :	
(i) For electrified Railway ...	Rs. 1,50,000
(ii) For other Railway	Rs. 75,000
Total (i) For Electrified Railway.	Rs. 2,50,000
(ii) For other Railway.	Rs. 1,75,000

i. e., approximately Rs. 15 lakhs for all Railways.

CHAPTER X.

STORES BRANCH.

10.1 General.

10.1.1 In examining the implications of the changeover to metric system in the Stores branch, due consideration should be given to the important features of the action common to all branches of Railways brought out earlier in Chapter III. It will be appreciated that the Railways main contact with the trade and industry in regard to their purchases, is through the Stores department. The pace of the changeover in this Branch will depend on the speed of the introduction of metric system in the industry of the country. On the other hand, the Stores branch would commence purchases in metric units only after the various consuming departments on the Railways are in a position to utilise materials to the new standards. It will hence be appreciated that this particular Branch on the Railways, will require sustained liaison not only with the various consuming departments, but also with trade and industry. We, therefore, wish to emphasise at the outset that the additional work-load on the Stores branch will be considerable.

10.1.2 We have stated earlier in Chapter III that it would be necessary to set up a Metric Cell in the Headquarter Offices of the Stores Branch on Zonal Railways. Besides its main function of directing the changeover in the Stores organization, this Cell would be called upon to maintain co-ordination with outside manufacturers and suppliers, in order to ensure a gradual and smooth replacement of the foot-pound system. The important functions of the Headquarter Cell are enumerated below :—

(a) Revision of price lists|nomenclature lists.

(b) Planning for the procurement of metric measuring equipment and adaptation of existing measuring equipment.

(c) Revision of local specifications and manuals.

(d) Estimation of the number of items requiring stocking in the dual system during the transition phase and planning for the necessary additional facilities.

(e) Co-ordination with suppliers and consumers for the progressive use of finished components, semifinished and raw materials on the metric system.

(f) Revision of forms.

(g) Arrangements for training of staff.

(h) Co-ordination with other Headquarter Metric Cells.

10.1.3 It has been recommended in Chapter III that the gazetted cadre of the proposed Metric Cell in the Headquarters Stores Branch should consist of one Senior Scale Officer. We have discussed with the Stores representatives of the Railways, the organization necessary for carrying out the functions outlined above, and we agree with them that besides the Senior Scale Officer, who would be incharge of the Headquarter Metric Cell, at least two Assistant Officers would be required for a period of 3 to 5 years, primarily for the work in connection with the revision of nomenclature lists. One of them would deal with the revision of nomenclature lists relating to the Mechanical Department whereas the remaining nomenclature lists would be the responsibility of the other. In the above context, we recommend the provision of two Junior Scale Officers for a period of about 3 to 5 years and suggest that they may, if found necessary, be posted at the major Stores depots. It would, in our view, be preferable to utilize technical officers against these posts and also provide additional non-gazetted technical staff from Electrical, Signalling and Telecommunication departments for this work.

10.1.4 Our discussions further reveal that there will be considerable increase in the number of purchase items during the transition period. It is estimated that the increase may be in the region of 40 60 per cent for certain classes of stores for a period of about 5 years commencing from 1959. Some Railways, therefore, considered it necessary to suitably strengthen the purchase section organisation, including the gazetted cadre, for this purpose. While we are unable at this stage to visualise the extent of additional work, we feel that due consideration should be given at the appropriate time for expanding the Stores Purchase organisation in the Headquarter Offices.

10. 2 We now deal with some of the important details of the functions of the Stores Cell outlined earlier.

10. 2. 1 Revision of Nomenclature lists.

10. 2. 1. 1 The nomenclature lists—till recently known as price lists—are the fundamental books of reference for Stores. They contain the following basic information relating to each item of stores :—

(i) List Number.

(ii) Description of article.

(iii) Drawing & specification reference.

(iv) Weight (where necessary).

(v) Unit for accountal (e. g. yard, gallon, each, etc).

In the existing lists, the prices are also usually indicated but it is learnt that this practice may be discotinued. It will be readily appreciated that the changeover will affect the lists in the following respects :—

Item (ii), Where description includes any reference to weight or measurement, e. g. Bars Claw 5' 6″ × 1⅛″, weight 20 lbs.

Item (iii), Where revised drawings or specifications may be involved.

Item (iv), this will obviously require revision.

Item (v), this will also mostly require to be changed.

10.2.1.2 There are as many as 36 classes of stores listed in a large number of price lists covering, on some Railways, a total of 40,000 to 70,000 items of stores. The colossal magnitude of work would, therefore, be readily appreciated, even though changes in the weights and measures units may be necessary in relation to 40 percent to 45 per cent of the items only. While alterations to nomenclature lists is primarily a function of the stores branch, it will generally be recognised that such revision can be effected only with the assistance and co-ordination of the consuming departments. The engineering branches of the Railway would be required to adopt the new standards on the metric basis and supply the necessary information to the Stores department to enable the latter to commence the preparation of the new nomenclature lists. While the adoption of the new standards in regard to screw threads, semi-finished and raw materials and small tools etc. could be finalised in a comparatively short period of time, it will be realised that the new drawing and specification references will become available gradually and as such we anticipate that this work would be completed only by about 1961-62.

10.2.1.3 During the course of our investigations, we gathered that the compilation of nomenclature lists, subsequent to regrouping of Railways, even on the existing system of weights and measures, was heavily in arrears. We also learnt that the progress in this direction had, so far, been extremely slow due to numerous unavoidable reasons. We wish to emphasise that unless this matter is taken up immediately with considerable determination, it may not become possible to complete the changeover to the metric system on the Railways even by 1970. We would, therefore, recommend that the existing organisation for the preparation of nomenclature lists should be suitably and immediately strengthened so as to make full use of the present opportunity for the revision of these lists consequent to adoption of metric system. We have indicated earlier the approximate requirements of officers and senior technical supervisory staff for this work. We may add here that adequate supervisory stores staff and other office staff would also be necessary.

10. 2. 2 Procurement and adaptation of measuring equipment—The existing equipment, weights and measures, etc., in the Stores depots required for day to day work are calibrated in the foot-pound system. During the transitional period, the Stores department would require measuring equipment in both systems, and as such, assets which can be recalibrated should be dealt with accordingly and arrangements made to procure the metric sets of measuring equipment where recalibration is not feasible. It would be appreciated that weighing machines, weigh-bridges etc., must be utilised for the normal serviceable period and should be kept in use either by recalibration or by reference to conversion tables. It will be desirable to initiate preliminary action in regard to the above immediately. As stated earlier in Chapter III, procurement of items such as scales, tapes, gauges, liquid measures etc., should be progressively carried out on the metric basis.

10. 2. 3 Stores Specifications and Manuals.

The Central Standards Office and other central agencies will be generally responsible for the revision of standard specifications and codes. The local Stores specifications and manuals, if any, would, howover, need to be revised under the guidance of the proposed Cell in the Head-quarter Offices.

10. 2. 4 Dual stocking during transition period.

10. 2. 4. 1 The most important feature of the impact of the changeover in the Stores Branch will be in regard to the increase in the number of stock items as it would be necessary to maintain stocks of duplicates on both the systems during the transition period. We find it difficult to assess, even approximately, the extent of increase in this direction but for the purposes of a rough study, items stocked in Stores may be grouped under the following three broad categories :—

(a) Group I.

This group may cover items as could be assessed in measurement readily convertible into any system. Pig iron, greases, waste cotton, oils, powders, paints, textiles, electrical cables, ropes, etc—where weight, volume or length etc., is the only factor for accountal—would fall in this group. It is estimated that this group will cover nearly 35—45 percent of the total stock items.

(b) Group II.

This group may consist of raw materials, semi-finished and finished materials, to specific sizes, which are generally procured from trade and where the sizes will be affected by the changeover to the metric system. Some of the examples are steel sections, plates, flats, rods, bolts, nuts, rivets, dies, taps, chasers, pipes, sheet and plate glass etc. It is estimated that approximately 15-20 percent of the total stock items could be included in this group.

(c) Group III.

In this group may be included the spare parts and components for rolling stock, machinery and plant and other equipment. They may comprise nearly 40—50 percent of the total stock items.

10. 2. 4. 2 As would be accepted, it will not be necessary to arrange for duplicate stocking of items in Group I. The changeover will affect a very vast majority of the items under Group II, and spare parts for standard rolling stock and equipment in Group III and duplicate stocking of such items during the transition period would be unavoidable.

10. 2. 4. 3 The above analysis would reveal that the Stores depots may be required to cater for additional stocking facilities for an increase of nearly 20-30 percent of the existing stock items. This is based on the assumption that nearly 60-70 percent of the items covered by Group II and 40-50 percent of the items in Group III, would require to be duplicated during the transition period. We propose to discuss the requirements of additional accommodation and additional staff for this purpose at a later stage in this chapter.

10. 2. 5 Co-ordination with suppliers and consumers.—For an appreciation of the nature of co-ordination it would be pertinent to recapitulate the principal functions of the Stores Branch. These are procurement of raw and other materials from trade, placement of manufacturing orders on railway workshops, supply of the necessary raw materials to workshops and stocking of shop manufactured items for ultimate issue to various consumars. The workshops will commence manufacture of metric design components only after receipt of raw metarials, measuring instruments and other equipment to metric standards. Since the Stores organisation is in constant touch with the trade and industry, it would be in a position to forecast the availability of metric materials and thereby assist in the advance planning for the manufacture of metric duplicates. It will, however, be appreciated that the Stores organisation will be dependent on the various engineering branches of Railways in regard to the timely selection of new standards of raw materials, and other manufacturing equipment, such as, measuring instruments small tools, cutters etc. The proposed Stores Metric Cell in the Headquarter Office must, therefore, maintain close and sustained co-ordination with the suppliers and the consumers.

10. 2. 6 Revision of forms.

Revision of forms would obviously be necessary both in regard to the change in any units of weights and measurements indicated there in and also in the matter of the new paper sizes. The above changes will apply to forms used by all branches of the Railways. The Stationery and Printing Department on most Railways has been placed under the charge of the Controller of Stores and we have, therefore, referred to the revision of forms in this Chapter. It is understood that the Indian Standards Institution will soon finalise the new standards for paper sizes.

10. 2. 7 Training of staff.

The majority of the Staff in the stores depots fall in the Class III category and we do not, therefore, visualise much difficulty in the matter of acquainting these men with the new system of weights and measures. Our discussions with various Railways reveal that besides the supply of conversion tables, charts and ready reckoners, a few Instructors may also be necessary for the purpose of training. It would, therefore, be desirable to provide one Instructor for each major Stores depot for a period of about one year. Some of the existing supervisory staff could also impart elementary training in the new system.

10. 2. 8 Co-ordination with other Headquarter Metric Cells.—The Stores Branch on the Railways is a common servicing organisation, catering to the needs of all Engineering and other branches. It would thus be readily accepted that the Headquarter Stores Metric Cells must maintain very close contacts with all other Cells in the Headquarter's Office in order to ensure a smooth changeover.

10.3 Procedural details.

10.3.1 The need for evolving a workable procedure for the changeover in the Stores depots is apparent and details were discussed with various Railways. We have suggested earlier that store stock items may, for purposes of this investigation, be divided into three groups and the procedural details for these are outlined in the subsequent paragraphs.

(a) Group I.

As stated earlier, the items included in this Group are those whose measurements can be assessed in readily convertible units. For this type of stores, it would be possible to adopt the new standards, as soon as the new measuring articles have been received at the Stores depots and by the consuming departments.

We found some divergence of opinion with regard to the manner of effecting the changeover for the items in this group.

Some were of the view that after adequate preparation, accountal of items in this Group should be changed over from a particular date, after which both receipts and issues should be in metric units. While all consumers will place their indents in metric units from this date, the Stores depots could convert any pending demands into metric units at the time of issue. A few were of the opinion that the changeover in the accountal system for items under this group should be introduced progressively by tackling a few classes of stores at a time synchronizing this change with metric supply from trade. This would obviously involve the fixation of separate D-days for different classes and the consequent issue of suitable circulars to all consumers from time to time. It is feared that this might lead to some confusion, and the consumers particularly may find it difficult to follow the instructions in regard to the system units at the time of preparation of indents for various classes of stores. We would, therefore, suggest that Railways should, if possible, adopt the first alternative. We do not anticipate any serious difficulty in following this method, as its adoption would not imply conversion of the balances against all items under this Group, on the appointed day. Conversion would obviously be carried out gradually at the time of the first transaction after this day. We may also add that enquiries made from the trade in the metric system should commence a few months earlier, so that most of the supplies after the appointed date are received in metric units.

(b) Groups II & III.

All items under Groups II & III which will entail any element of re-design as a result of adoption of the **metric** system, will have to be stocked as new items and would, therefore, involve the opening of separate cards. Hence this will be a very gradual process but would ultimately result in considerable increase in the number of stock items at various Stores depots. It is important to point out here that while duplicate stocking of a large number of parts would be inescapable during the transition period, it would not necessarily lead to a corresponding increase in the consumption of any particular component. Whereas the demand for the metric design components would gradually increase, the requirements of the corresponding foot-pound spares will decline. It will, therefore, obviously become necessary to continue revising the basis for the fixation of minimum and maximum limits of stocks against particular items. We would stress that considerable thought should be given to this matter in order to minimise, if not completely avoid, any surplus stocks of foot-pound duplicates towards the end of the transition phase.

10. 4 Additional Facilities.

We now propose to analyse the likely requirements of additional accommodation for stocking materials as also the need for more staff in the Stores department. While the proposed increase in these facilities may appear to be of temporary nature, mainly for the purpose of dealing with additional items required to be stocked during the transition period, we are of the view that all these additional facilities would be fully utilised on a permanent basis due to continous and rapid development of the railway system.

10. 4. 1 Accommodation.

The expected increase in stores stock items consequent to the introduction of the metric system of weights and measures, has been estimated at about 20-30 percent of the existing number. The total area of the

Stores depots of the railway system varies at present from about 3 to 6 lakhs square feet. Though we have made a rough estimate of the likely over-all increase in the number of stock items on a Railway, it is difficult to even roughly estimate the additional accommodation required for this purpose. In any case, we would not suggest a proportionate increase in stocking area as at no stage will any of these items carry 100 per cent additional stock. We are, therefore, of the view that an additional provision of about 15 per cent in stores depots accommodation would be necessary due to the increase of stores holdings as a result of the introduction of the metric system. It may incidentally be mentioned here that Railways have planned considerable increase in their stocking facilities during the Second Five Year Plan and it is possible that some of the additional accommodation being so planned, may become available for accommodating the metric duplicates.

10. 4. 2 Staff.

In view of what has been stated in the foregoing paragraphs, it will hardly be necessary to repeat the basis for estimating the additional staff for this purpose. We would, however, suggest that the increase in staff should be effected very gradually and should be brought about as and when there is considerable increase in the number of items in stock. The overall increase at any stage during the transition period, may not exceed about 10-15 per cent of the present by strength of staff in Stores depots.

10. 5 Before discussing the phasing in the Stores Branch, we briefly deal here with a few miscellaneous aspects of the changeover connected with the Stores organisation.

10. 5. 1 We have already stated earlier in Chapter VI, that it would be advisable to distinctively mark some of the metric design components to eliminate the possibility of any confusion at the time of storing and usage of such spares. The Representatives of Railways were also of similar views. This aspect will however, require detailed examination.

10.5.2 At one stage, it had been suggested that stock verification should be carried out at the time of conversion of stores balances. While this would neither be necessary nor a workable proposition, we cannot help recording that the Stores Branch will have to ensure that no errors intentional or otherwise, are allowed to creep in at the time of conversion of stock balances into metric units.

The process of conversion may, however, lead to a slight percentage error between the physical ground balances and the book balances, as theoretically arrived at by the use of conversion tables. This would however be negligible and whereever considered necessary, suitable instructions for rounding off should be issued.

10.5.3 Some the smaller items of stores, such as screws, pins, washers etc., are accounted for in dozens and grosses. These units will obviously disappear and accountal made in multiples of ten.

10.6 Phasing of the changeover.

The sequence of the important aspects of the phasing of the changeover in the Stores Branch is outlined below:—

10.6.1 Preparatory Phase—5 years (1957—62).

(a) Setting up of Stores Metric Cell at Railway Headquarters—December, 1957.

(b) Re-calibration of existing weigh-bridges, weighing machines etc., to read in dual units—to commence by June, 1957.

(c) Procurement of metric measuring equipment—to commence as early as possible.

(d) Preparation of new nomenclature lists—to commence immediately.

(e) Creation of training facilities—by December, 1958.

(f) Revision of forms —to commence from January, 1958.

(g) Revision of local manuals and specifications—to commence from January, 1958.

(h) Planning and provision of additional storage accommodation—to commence from January, 1958.

(i) Introduction of metric system in accountal—from 1-4-59.

10.6.2. Transitional Phase—5 years (1962—67).

In the initial stages of this phase, there would be an increase in the number of store stock items due to dual stocking of the foot-pound and the redesigned duplicates. Gradually, the demand for the foot-pound duplicates would decrease by the end of the phase, the metric system would be, more or less fully established.

10.7 Financial Implications.

The approximate estimated cost of the changeover to the metric system of the Stores Branch of a zonal railway is indicated below:—

Items of work.	Estimated average cost per Railway.
(a) Stores Department Metric Cell at Railway Headquarters.	(Included in Chapter III)
(b) Recalibration of weighing machines and weigh-bridges; provision of additional metric measuring equipment, etc.	Rs. 50,000
(c) Training of Staff.	Rs. 15,000
(d) Revision of price nomenclature lists.	Rs. 3,00,000
(e) Provision of additional storage accommodation.	Rs. 5,00,000
(f) Additional staff for dealing with the increase in store stock items.	Rs. 5,00,000 to 10,00,000*
Total per Railway.	Rs. 16,00,000

Total i. e., Rs. 112 lakhs for all Railways.

(*This figure is very approximate and an accurate estimate at this stage is not possible).

CHAPTER XI.

TRAFFIC AND COMMERCIAL BRANCH.

11. 1 General.

11. 1. 1 In contrast to the substantial impact of the changeover on the various engineering branches of the Railways, the introduction of the metric system of weights and measures in the Traffic and Commercial Branch would be comparatively easier. This Branch will also not be dependent, to any great extent, on trade and industry for the purpose of initiating action in this matter. In fact, it has been suggested that the Traffic and Commercial organisation of the Railways should take a lead and aim at the completion of the changeover within a period of about 2 to 3 years and thereby assist in popularising the metric system of weights and measures among the masses and stimulating the changeover in the industry. With exception of certain internal preparatory steps such as revision of distance, fare and rate tables, recalibration of weighing machines and weighbridges, etc., no special measures or co-ordination with the other sectors would be necessary.

11. 1. 2 Unlike the Engineering branches of the Railways, there could obviously be no transition phase in the Commercial Branch during which the present and metric systems of weights and measures would operate simultaneously. As soon as the necessary preparatory steps discussed in the subsequent paragraphs have been completed, a complete and sudden changeover should be made from a particular date and no transactions thereafter in the foot-pound system should take place in this Branch.

11. 1. 3 The Traffic and Commercial Cell proposed to be set up in the Headquarter Offices of the Zonal Railways (refer Chapter III) will be responsible for organising and directing the changeover in this Branch. We discuss at a later stage in this chapter the important functions of this Cell.

11. 2 Commercial branch.

11. 2. 1 Policy Issues.

11. 2. 1. 1 The Commercial branch is responsible for all work connected with the weighment and measurement of goods tendered for despatch and the application of rates and fares according to distance. The Railways would, therefore, naturally require Board's decisions on the important issues of the new units of weight and distance to form the bases of rates and fares, expression of maxima and minima, method of rounding off etc., before any work in connection with the changeover in this Branch could be initiated. Since on such matters, the Railway Board are usually assisted by the Railway Commercial Committee, we also obtained their views before formulatiug our recommendations.

11. 2. 1. 2 The changes involved in the switch over to the metric system in the Commercial branch are primarily in respect of weights, dis-

tances, areas and cubical capacities. With the alteration of these units to the metric basis, the existing tariff will have to be modified. In this connection we may also add that decimal coinage is being introduced in the country on and from 1-4-1957 and the question of revision of tariffs from the "pie" to "naya paisa" basis due to this change must already be under consideration of the railway administration. While the basic tariffs in respect of the monetary values only could, if required, be altered in a short period of time, we would suggest that the revision of the tariff structure should be undertaken only after the preparation of the revised basic documents such as the sectional distance tables, station to station distance tables, ready reckoners etc. on the metric basis. This would avoid separate revisions for the introduction of decimal coinage and metric system of weights and measures and a reference on this subject has already been made by us to the Board as pointed out earlier in Chapter I, paragraph 1.3.2.

11.2.1.3 We discussed with the Railways the question of work load involved in the preparation of the basic documents in metric units, referred to above. We agree with the views of the representatives of the Commercial Branch of the various zonal Railways that a period of 18 months to 2 years would be required for this work apart from the initial time required by the Civil Engineering Branch for compiling the station to station distance tables in kilometres. We, therefore, visualise that all preparatory work for the changeover in the Commercial Branch would be completed by the end of 1959.

11.2.1.4 It has already been suggested earlier that it would be desirable to carry out simultaneous revision for coinage and weights and measures. The present system of coinage would go out of use from 1-4-60 and since the end of the preparatory period for the changeover to metric system in the Commercial Branch, as stated above, roughly coincides with this date, the revision of the tariff structure for both these changes may be carried out simultaneously and brought into effect from 1-4-60. During the period 1-4-57 to 31-3-60, the existing bases may continue to remain in force and only the total charges may be converted and expressed in terms of the new coinage. The Commercial Committee also concurs with this proposal.

11. 2. 1. 5 We may add here that the Government of India have appointed the Railway Freight Structure Enquiry Committee whose report has recently been submitted to the Railway Board. The recommendations of this Committee may considerably affect the freight structure of the Indian Railways. It would obviously be advisable to revise simultaneously for decimal coinage and metric weights and measures, the bases of rates for goods and other coaching traffic only after consideration of the recommendations of the Railway Freight Structure Enquiry Committee.

11. 2. 1. 6 As stated earlier, the new units of weight and distance for charge, expression of maxima and minima and method of rounding off etc., would have to be decided upon before any work could be initiated by the Commercial Branch. These are briefly discussed below.

(a) Unit of distance.

The obvious choice for the new distance unit would be a kilometre as this has been accepted in most of the countries which have adopted metric system of weights and measures. At present, a fraction of a mile is taken as one mile in calculating the distance for charge, and a similar policy may be adopted for the kilometre unit. The Commercial Committee also concurs with these views.

(b) Units of weight.

The maund is the unit of weight in the present system though the statistics are generally compiled in tons. The kilogram, being a much smaller unit of weight, cannot be adopted as the new basic unit. Our discussions with the Railways and the views of the Commercial Committee in this connection lead us to the conclusion that it would be desirable to adopt the 'quintal' (100 kilograms) as the basic unit of weight for charge in the new system.

At present fractions of a maund are charged in 10 seer units in the case of goods traffic and 5 seer units for parcels. These may be replaced by 10 kilograms and 5 kilograms units. For accountal of coal and other mineral traffic, the metric ton (1,000 kilograms) may be adopted as the new unit and fractions of a metric ton may be charged in 200 kilograms units.

(c) Unit of area, volume and capacity.

The obvious choice for the unit of area in relation to wagon floor space, would be the square metre and this would replace the existing unit of square foot. Similarly the cubic metre unit would be used as a measure of volume in the new system and litre as the measure of capacity.

(d) Method of rounding off of fares and rates and expression of maxima and minima.

We understand that this aspect is receiving the attention of the Commercial Committee and we do not propose to deal with this issue in our Report.

11. 2. 1. 7 We have stated earlier in this chapter that the complete changeover to the metric system should be brought into effect in the Commercial Branch of the Railways from 1-4-1960. The bulk of the transactions in respect of goods traffic are based on the carrying capacity, tare weight and floor area of goods stock. These are at present on the foot-pound system. With a view to facilitate the working in the Commercial Branch to the new system from 1-4-1960, it would obviously be desirable to ensure that the entire goods stock on line after this date should indicate the capacity and tare weight in metric units. Since the various legends on wagon stock are stencilled in workshops at the time of periodical overhaul which is normally given at intervals of 3 years, it would obviously be necessary to commence at once the stencilling of metric units in addition to the existing markings, so that the entire wagon stock would be completed in this respect before 1-4-1960. We may also add here that in the event of the acceptance of our suggestion for a complete changeover to the metric system in the Commercial Branch from 1-4-1960, wagons turned out of workshops after that date should be stencilled in the metric units only. We have already referred to the necessity of early action in this regard in Chapter VI, paragraph 6. 6 (a).

11. 2. 2 Revision of basic data.

11. 2. 2. 1 The Railway Board and the Indian Railway Conference Association are normally responsible for the preparation and revision of the Coaching, Goods, Military and Red Tariffs. It would, therefore, be readily accepted that the revision of these documents for the adoption of the metric units and decimal coinage would be arranged by

the Central Authority. The revision of the above mentioned tariffs would be mainly in respect of the minimum distance for charge, the minimum weight for carriage by goods trains, the minimum charge, the rates for terminals, transhipments and short distance charges and similar other items. The new metric unit markings on wagons will also have to be notified in the tariffs. The existing bases of rates and fares for items such as wagon load scales, parcels rates, luggage rates, floor area rates etc. will need to be revised in terms of decimalised currency and metric weights and distances.

11. 2. 2. 2 Passenger fare tables, goods and parcels ready reckoners providing calculated charges for distances in terms of kilometres would also have to be prepared afresh.

11.2. 2. 3 While a major portion of the work load in connection with the above items will fall on the Indian Railway Conference Association, the Board would, as in the past, nominate particular Railways for compilation of ready reckoners.

11. 2. 2. 4 Normally the Goods and Coaching Tariffs are revised and published after every 2 or 3 years. It has been estimated that the revision and publication of a tariff can be completed by two experienced clerks in a period of about 8 months. Estimates for the revision of all the four tariffs within a period of about 6 months reveal a staff requirement of about 10 senior clerks and 5 junior clerks apart from the ministerial supervisory staff. The publication of the revised tariffs within the target period would be dependent on the availability of printing facilities.

11. 2. 2. 5 The compilation of fare tables can be carried out in about 6 to 8 weeks and parcels and goods ready reckoners in about 8 months It is estimated that a total of about 8 clerks including 2 clerks in senior grade would be needed for this purpose by the Railway or Railways entrusted with this work.

11. 2. 3 Zonal Headquarters Cell.

11. 2. 3. 1 It has been indicated earlier in Chapter III that it would be necessary to set up a Metric Cell in the Traffic and Commercial Branch in the Headquarters Office under the charge of a Junior Scale Officer for a period of about 2 years. In so far as the commercial aspects are concerned, the Rates Superintendent would also generally guide these Cells in directing the changeover. It would also be necessary to provide a few Commercial Inspectors and other office staff to man these Cells apart from the staff required for revision of distance tables, local tariffs, manuals, time tables, etc.

11. 2. 3. 2 We now propose to deal with some of the important functions of the Metric Cell to be set up in the Traffic-Commercial Branch of the Headquarters Office of each zonal railway.
These are enumerated below:—

(a) Preparation of sectional kilometre tables, station to station kilometre tables and junction kilometre tables.

(b) Revision of local tariffs, coaching guides, manuals, forms, station working rules etc.

(c) Arrangements for recalibration of existing weighing machines and weigh-bridges.

(d) Arrangements for printing of tickets, way-bills etc. indicating metric units.

(e) Arrangements for training of staff.

(a) Revision of distance tables.

It will be observed that the Commercial branch could commence action in regard to the preparation of kilometre distance tables soon after the receipt of station to station kilometre distances from the Civil Engineering branch. The Civil Engineering branch would be required to supply kilometre distances for every station on a particular section in relation to the selected originating point on that section. It would, as such be essential for the Civil Engineering branch to prepare the kilometre distances in this manner for every section. We may repeat here that the converted figures of kilometre distances should be rounded off to two places of decimal by the Civil Engineering branch and it would be for the Commercial Branch to work out the chargeable distances between stations. This work is not dependent on the issue of revised tariffs of the Indian Railway Conference Association, ready reckoners, etc.

Our discussion with the Railways revealed that the quantum of work involved in the preparation of these tables would be considerable and a large body of additional staff would be necessary for a period of about 12 to 18 months for this purpose. We would suggest that the desirability of executing this work by means of electrically operated calculating machines be kept in view.

(b) Revision of local tariffs, etc.

After the revision of Indian Railway Conference Association Tariffs and the preparation of ready reckoners, etc., it would be necessary for the zonal Railways to revise the local tariffs, such as coaching guides, local goods tariffs and coal tariffs, etc. The revision will apply to exceptions to general rules, station to station rates, siding charges, lump-sum wagon rates, out agency rates, etc. Gazette notifications, local manuals, forms etc. will also require revision. It is estimated that this work could be completed in about 6 months. In the case of Southern Railway, revision of Indo-Ceylon Coaching and Goods Pamphlets would also be involved.

(c) Recalibration of existing weighing equipment.

Recalibration of existing weighing machines and weigh-bridges would obviously be necessary. Our discussions with the representatives of the Commercial branch of the Railways revealed a considerable degree of unanimity for providing dual calibrations on our existing assets of this type. It was suggested that after recalibration, the weighing machines should read both in maunds and kilograms, whereas the weigh-bridges should show the present and metric tons. Markings in both the systems would be necessary only in respect of equipment which could be attended to before the date of complete changeover in the Commercial department. Any weighing equipment recalibrated after this date should only show the metric units.

We understood that recalibration work would have to be generally carried out by outside agencies and though some indication of the cost of conversion was obtained from a few firms, it is not possible to correctly assess the cost of such work and, therefore, only an ad hoc provision has been indicated under "Financial Implications". As stated earlier in Chapter III, each Railway may have to obtain a few additional weighing machines to permit the recalibration of the existing units. With regard to the purchase of new weighing equipment, the Board's policy for the acquisition of new machinery and equipment, has already been, indicated in Chapter I.

(d) Printing of new tickets, way-bills etc.

With the revision of the basic units of charge, it would become necessary to print new tickets, way-bills, invoices, etc. showing kilometre distances and fares in decimalised currency. Modifications to the existing ticket printing machines for the printing of new tickets are not expected to present any difficulties. In the case of automatic ticket printing machines, a change in the stereos would be entailed.

(e) Training of staff.

The Commercial staff such as station masters, goods, parcels and tally clerks, booking and delivery clerks, ticket collectors and checking staff, etc. will not require any specialised course of training. It would, however, obviously be desirable to impart preliminary instructions in regard to the new units of weights and measures and also arrange supply of conversion tables. A short course of instruction on the metric system should be included in the curriculum of all Railway Traffic Training Schools.

It would be necessary to appoint a roving Instructor for each Division for a period of 3 months, prior to the date of changeover and 6 months following the change, for educating the staff in the new system. All regular Commercial Inspectors would, of course, also assist in the education of staff in the new system.

In order to assist the traders and the public at large, it would be necessary to display the conversion tables and charts prominently at Goods sheds, Parcel and Luggage offices during the transition phase. The Publicity Branch of Railways would, of course, assist in the effective presentation of such information.

11.2.4 Catering Branch.

In the Catering Branch, both the British and Indian systems of weights and measures are in use at present. In this Branch the adoption of the new units of weights could obviously be suitably arranged without much difficulty. The catering branch would, in due course, have to procure adequate number of new weights and measures to replace the existing seersweights, standard containers, etc. The current schedule of ingredients for various recipes would require revision. The financial implications of the changeover in this Branch would be insignificant.

11.3 Transportation (Traffic) Branch.

11. 3. 1 This Branch will be the least affected by this changeover. We have indicated earlier in this chapter the procedure for the compilation of station-to-station kilometre distance tables. The Transportation Branch will be required to show these kilometre distances in the various time tables and we visualise that there will be considerable work involved in the preparation of the first set of time tables based on kilometre

distances. The booked speeds, the maximum permissible speeds and speed restrictions are indicated in the working time tables and these will need to be expressed in kilometres per hour.

11.3.2 Of the other important documents to be revised in this Branch, may be mentioned the station working rules, local Traffic manuals, Subsidiary Rules etc. It would obviously be necessary for this Branch to await the revision of general rules, particularly in respect of the moving dimensions and 'adequate distance' before any revisions of the above mentioned documents could be taken in hand. Modifications to standard forms such as Guards journals, Vehicle Guidance, Statistical forms etc., would also be necessary in order to incorporate metric units.

11.4 Phasing of the changeover.

It has been brought out earlier that a complete changeover to the metric system of weights and measures as well as decimal coinage could be effected in the commercial branch from a fixed date after a brief preparatory period of 2 to 3 years. Action in the Branch will, therefore, be confined mainly to the preparatory phase and a complete and sudden changeover would take place at the end of this phase. The sequence of important steps necessary during the preparatory phase (1957-60) is set out below:—

(a) Recalibration of weighing machines and weigh-bridges —to commence immediately.

(b) Stencilling of tare weight, carrying capacity, floor area etc. in dual units on goods stock during periodical overhaul—to commence immediately.

(c) Setting up of the Traffic and Commercial Branch Metric Cell in the Headquarters of the zonal railways—January, 1958.

(Note:—The Civil Engineering Branch should, have supplied the station to station kilometre distances by this time).

(d) Preparation of sectional, station to station and junction kilometre distance tables—to commence by January, 1958.

(e) Creation of training facilities, supply of conversion tables, publicity of the new system at goods, parcels and luggage booking offices etc.—by September, 1959.

(f) Revision of the Indian Railway Conference Association Tariffs. Preparation of goods and parcels ready reckoners, passenger fare lists etc. incorporating both decimal coinage and metric weights and measures—to be completed by December, 1959.

(Note:—This work would obviously be possible only after basic decisions of the new units of weight and distance for bases of rates and fares, method of rounding off etc., have been advised by the Board).

(f) Revision of local tariffs, coaching guides, manuals, forms, gazette notifications, station working rules etc.—to be completed by December, 1959.

(h) Printing and stocking of revised passenger tickets, invoices, way-bills etc.—by December, 1959.

(i) Change to the new system — 1-4-1960.

11. 5 Financial Implications

A rough estimate of the expenditure for the changeover in the Traffic and Commercial Branch of a zonal Railway system is given below:—

	Items of work	Estimated average cost per railway.
(a)	Traffic and Commercial Branch Metric Cell at Railway Headquarters.	(Included in Chapter III).
(b)	Recalibration of weighing machines & weight-bridges including provision of additional weighing machines and replacement of loose weights on beam scales.	Rs. 5,00,000
(c)	Preparation of kilometre tables and revision of local tariffs, forms, coaching guides, etc.	Rs. 1,50,000
(d)	Training of staff.	Rs. 30,000
	Total..	Rs. 6,80,000 per Railway.
(e)	Revision of Indian Railway Conference Association Tariffs and preparation of ready reckoners.	Rs. 30,000 (common to all Railways)

i.e. approximately Rs. 48 lakhs for all Railways.

CHAPTER XII.

MEDICAL BRANCH.

12. 1 General.

12. 1. 1 we are of the view that the engineering departments of the Railways are likely to set the pace in the matter of the changeover to the metric system in the field of engineering industry. While the Railways can take initiative in [this sphere, we would like to emphasise that the Medical Department of the Railways must await the directives of the Ministry of Health in this connection. We have, however, held general discussions with the Medical Officers of the Railways and it would appear that the Medical profession in the country would be required to proceed somewhat on the lines indicated in the following paragraphs :—

12. 1. 1. 1 It would be desirable to gradually introduce the metric system in the training curriculum of all medical institutions so that pharmacists and medical students are trained in the use of metric units. It will generally be accepted that the Railways cannot make any contribution in this sphere.

12. 1. 1. 2 The Central Medical Authority of the Government of India would, in due course, arrange for the revision of relevant text books, dosages in medical books, vocabulary of medical stores, etc. It would also become necessary to show the metric equivalents in the Indian Pharmacopoeia and other Hospital Pharmacopoeia. Here again, the Railway Medical Branch will not be in a position to initiate any action.

12. 1. 1. 3 Production of various types of medical and surgical equipment, glass measures, weights etc. on the metric sizes should commence soon after the new standards have been evolved. The Railways would naturally be dependent on supplies from the trade and would plan for procurement of the metric stores according to availability in the market.

12. 1. 1. 4 It would also become necessary for the issue of instructions to manufacturers of drugs and medicines to indicate dosages of their products, both in the existing and metric units, for some time. It will be realised that the Railway Medical Branch cannot initiate any action in this sphere also.

12.1.1.5 It would be necessary to arrange for special publications on metric system of weights and measures with corresponding equivalents of weights and measures on the existing system and widely distribute these publications through appropriate agencies.

12.1.2 We have outlined above the general preparatory steps of an essential nature which must necessarily precede the adoption of the metric system in the medical profession. It is difficult at this stage to assess the nature and quantum of the additional work load in the Medical Department on Railways and hence, we hesitate to make any positive recommendation regarding the necessity of providing additional staff in the Headquarter Cells. We have, however, generally indicated in

Chapter III that it would become necessary to nominate one of the Medical Officers in the Headquarters Offices to arrange for the implementation of the instructions received from the Ministry of Health.

12. 2 Training of Staff.

In the absence of any indication of the nature of training that may be considered necessary for the existing medical staff in order to acquaint them with the metric system of weights and measures, it is obviously difficult to indicate the extent of additional facilities which would be necessary for this purpose. We, however, visualise that the Ministry of Health would make suitable arrangements for the required training at various medical institutions and it may be possible for the Railways to send their staff in batches to these centres. The strength of relieving staff in various categories may, therefore, have to be suitably increased. It is, however, not possible for us at this stage to give even an approximate indication of the additional relieving hands required for this purpose.

12. 3 Replacement and re—calibration of existing equipment.

A part of the existing medical and surgical equipment and other appliances in railway hospitals, dispensaries, accident relief medical vans, etc. is generally graduated in the existing system of units. Of the important items of equipment which would require replacement by the metric design articles, we may mention here measuring glasses, thermometers, dispensers weights, measuring tapes, etc. These normally require replacement at periodical intervals varying from a few months to two or three years. On the other hand, equipment such as weighing machines, height measuring stands, linear scales on X-Ray equipment, pressure gauges on auto-claves, sterlizers and gas cylinders, etc. would generally lend to recalibration. We suggest that the Medical Branch should consider the implications in greater detail and plan out the replacement and recalibration work in a suitable manner.

12. 4 Phasing of the changeover.

It has been stated earlier in this Chapter that Railways will not be in a position to initiate any action for the changeover in the Medical Branch, until necessary directives are received from the Ministry of Health. We therefore cannot, at this stage, suggest any phasing for the Medical Branch but it would appear that the changeover can be easily completed within the stipulated period of 10 years.

12. 5 Financial Implications.

For obvious reasons, we cannot attempt even an approximate estimate of the cost of the changeover in the Medical Branch. During the course of our investigations, we were generally informed by the representatives of the Medical Department that the approximate cost of replacement and recalibration of the existing assets, would be in the region of about Rs. 25,000 per Railway. This includes the cost of additional medical books of reference which may have to be supplied to all hospitals and dispensaries.

CHAPTER XIII.

ACCOUNTS BRANCH.

13.1 General.

13.1.1 The introduction of the metric system will not directly affect the working of the Accounts Branch in the initial stages of the transition period. As the changeover progresses in the other branches of the Railways, the Accounts Branch would also feel the impact, particularly in the Stores and Engineering Accounts Sections.

13.1.2 A nucleus Accounts Cell under the charge of a Junior Scale Officer, as already indicated in Chapter III, would be required to be set up at each Headquarter Office of the zonal Railways. Provision of other office staff, including an Accountant would also be necessary. The Accounts Cell should be set up only after the work relating to the changeover in the other branches gathers momentum and may be required for a period of about two years. This Cell will co-ordinate with the Metric Cells of the other branches in regard to the issue of instructions where accountal is involved and also generally assist the Accounts wings of the administration which will be affected by the changeover. It will also arrange for the training of staff including provision of conversion tables and ready reckoners, revision of local manuals, etc.

13.2 We now propose to discuss briefly the important implications of the changeover in the major sections of this Branch.

13.2.1 Engineering Accounts Section.

The introduction of the new system of weights and measures would call for an early revision of the schedules of rates. It is understood that the revision of these schedules normally entails Accounts verification. It will be appreciated that the 'works' under contracts executed before the new schedules of rates are brought into use, would be measured and billed in the foot-pound system. The two schedules will, therefore, remain simultaneously in use to this extent but it should not throw any appreciable additional load on the expenditure section of the Accounts Branch. It is estimated that an additional bill clerk in each division would be adequate for dealing with this work.

13.2.2 Stores and workshop Accounts Sections.

There will be considerable increase of work in the Stores Accounts Section, particularly of the ledger clerks and stock verifiers, due to the anticipated increase in the number of stock items and consequent increase in the number of transactions. It has been estimated earlier (Chapter X) that the increase in the number of stock items may be of the order of 20-30 percent. As estimated in the case of Stores staff, provision of about 10-15 percent additional staff may also be found necessary in the Stores Accounts Section.

There would also be a slight increase of work consequent to the increase in the number of stores transactions, in the Workshop Accounts Offices, particularly in the section dealing with the stores sub-ledgers, pairing of issue notes etc. An additional clerk for each Workshop Accounts Office may be found necessary for dealing with this work.

13. 2. 3 Traffic Accounts Section.

We understand that the Traffic Accounts Section is not normally called upon to check fare and rate tables even during routine revisions. Some additional work may, however, arise in connection with the checking of special and local rates revised by the Railway. There will also be an increased checking of indents and classifications for a short period.

13. 3 Financial Implications.

A rough estimate of the cost of changeover in the Accounts Branch of a zonal Railway, is indicated below:—

Items of work.	Estimated average cost per Railway.
(a) Accounts Branch Metric Cell at Railway Headquarters.	(Included in Chapter III)
(b) Training of staff.	Rs. 10,000
(c) Additional staff for temporary increase in work in the Engineering, Workshop & Stores Accounts, Traffic Accounts Sections, etc.	Rs. 3,00,000
Total : per Railway	Rs. 3,010,000

Total : i.e. approximately Rs. 22 lakhs for all Railways.

CHAPTER XIV.

CONCLUSION.

14.1 In this concluding chapter we propose to briefly review the time and cost aspects of the changeover to the metric system of weights and measures on the Railways.

14.2 The Standards of Weights and Measures Act., 1956 lays down a total period of 10 years for the complete changeover to the new system in the country. The present system of weights and measures is, therefore, required to be completely superseded by 1966 by the metric units. In the foregoing chapters we have attempted to outline the essential features and the sequence of phased action necessary in each branch of railway working and we are generally of the view that the changeover could be brought about in most of the branches within the stipulated period. It has, in fact, been indicated in Chapter XI that a complete changeover in the commercial organisation of the Railways—through which we mainly deal with the outside trade and public—could be effected by 1-4-60 i. e., withing 3 years. In the Mechanical Engineering Branch, however a minimum transitional period of 12 to 13 years has been visualised with a view to reducing the work load, particularly in regard to the range of equipment to be considered for redesigning to metric standards. Since this will primarily concern the internal usage and maintenance of railway engineering equipment, it should not come into conflict with the main provisions of the Act. While it may not be possible to completely eliminate the use of the foot-pound system in regard to the maintenance of a limited number of engineering machinery and equipment, we are inclined to conclude that the Railways would be able to adopt the metric system almost in all spheres of working, in a period of about 15 years at the outside.

14.3 We have also given in the earlier chapters, an indication of the estimates of the financial outlay involved in bringing about the change to the metric system on Railways. These estimates have been further summarised in Chapter XV and it will be observed that the approximate total cost, as estimated at present, spread over the entire transition period for the Indian Railways is in the region of rupees six and a half crores. In Chapter I, paragraph 1.3.4, the difficulties in formulating an accurate assessment of the cost of the changeover have been expressed, and we reiterate that the estimate should be treated only as a fair indication of the cost of changeover. It will be generally appreciated that the bulk of the cost of changeover would be debitable to Revenue Heads of Accounts.

14.4 Our investigations and discussions with the Railways have enabled us to outline the important implications of this changeover in the various fields of railway working. It would be realised that the problems as they arise progressively, during the various phases of the changeover, would require close examination in order to determine the most effective, economic and expeditious solutions. It is likely that some of the implications of the changeover may not have been fully covered by our investigations.

We have also indicated earlier that it may not be possible to avoid completely minor setbacks in production, outturn, maintenance and operation during the transition period but we would emphasise that with careful planning and co-operation of the trade and industry in general, the difficulties will not be insurmountable.

14.5 We trust that our analysis of the subject and the lines of action indicated in this Report would provide adequate guidance on the suitable policies and procedures to be adopted. We also hope that our suggestions and recommendations will be found useful and go a long way in minimising the difficulties inherent in the adoption of a completely new system of weights and measures.

4.6 Acknowledgements.

We are extremely grateful to the railway administrations for providing us with valuable information in response to our questionnaire and also for useful contribution made by them during the course of discussions held with our Sub-Committee. We also wish to place on record the valuable assistance rendered by the Railway Commercial Committee, the Indian Standards Institution and the Standing Metric Committee, which helped us in framing our recommendations.

We are thankful to the Members of our Sub-Committee who, in addition to their normal work, undertook the responsibility of carrying out detailed discussions with railway administrations and drafting of the final report.

We wish to place on record the commendable zeal and ability with which our Secretary, Shri J.P Gupta, planned and conducted the investigations and put up a large volume of information in a well thought out sequence, thereby enabling us to formulate our report. We would also like to express our high appreciation of the hard work put in by the other staff of the Secretary's organisation.

S. L. Kumar
Chairman,
Railway Metric Committee.

Members

P. N. Murty
K. C. Sood
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C. S. Lall
D. R. Suri
H. Ramamoorthy
I. C. Bhatt

J. P. Gupta
Secretary,
Railway Metric Committee.

CHAPTER XV.

SUMMARY OF FINANCIAL IMPLICATIONS.

	Particulars	Estimated cost in lakhs of rupees.
1.	Railway Board Metric Cell. (Chapter III, para 3.1.1.5)	4.0
2.	Metric Cells at Headquarter Offices of Railways. (Chapter III, para 3.1.2.5)	38.5
3.	Central Standards Office. (Chapter IV, para 4.11)	43.0
4.	Civil Engineering Branch. (Chapter V, para 5.5)	77.0
5.	Mechanical Engineering Branch. (Chapter VI, para 6.10)	266.0
6.	Chittaranjan Locomotive Works. (Chapter VII, para 7.2.5)	10.75
7.	Integral Coach Factory, Perambur. (Chapter VII, para 7.3.8)	11.5
8.	Signal and Telecommunication Engineering Branch. (Chapter VIII, para 8.7)	8.0
9.	Electrical Engineering Branch. (Chapter IX, para 9.7)	15.0
10.	Stores Branch. (Chapter X, para 10.7)	112.0
11.	Traffic and Commercial Branch. (Chapter XI, para 11.5)	48.0
12.	Medical Branch. (Chapter XII, para 12.5).	1.75
13.	Accounts Branch. (Chapter XIII, para 13.3)	22.0
	Grand Total Rs.	657.5 lakhs.

CHAPTER XVI.

SUMMARY OF RECOMMENDATIONS.

1. A Metric Cell should be set up immediately under the Additional Member Mechanical of the Railway Board, to plan and direct the changeover to the metric system on Railways. The Cell should consist of one Joint Director from the Mechanical Engineering branch and one Deputy Director each from the Civil Engineering, Stores and Traffic (Transportation & Commercial) branches.

   (Chapter III, paras 3. 1. 1. 1 and 3. 1. 1. 3)

2. The Railway Board Metric Cell should arrange for the immediate revision of the Railway Board's codes and publications, particularly the Schedule of Dimensions, I. R. S. Limits and Fits, Way & Works Manual and State Railway Engineering Code.

   (Chapter III, para 3. 1. 1. 4. & Chapter V, para 5. 1. 3)

3. Metric Cells should be set up in each branch at the Headquarter Office of each Railway for planning and effecting the changeover.

   (Chapter III, para 3. 1. 2. 1)

4. The expeditious implementation of the changeover will depend on the availability of an adequate number of experienced draftsmen. In order to attract and retain suitable men, the number of additional posts in the higher grades in major Drawing Offices should be considerably increased during the period of the changeover and the outstanding among them should be promoted to fill additional gazetted posts to supervise this work.

   (Chapter III, para 3. 2. 1. 4)

5. All recruiting agencies for Railways should include an elementary test of the knowledge of the metric system in their syllabi.

   (Chapter III, para 3. 2. 1. 6.)

6. Railways should initiate early action in the matter of recalibration of weighing machines and weigh-bridges to show in addition the metric units of weights.

   (Chapter III, para 3. 2. 2. 3)

7. In order to adopt the metric system, mere endorsement of the exact equivalents of inch dimensions on drawings of standard engineering equipment will ordinarily be of little practical utility. Redesigning of the normally replaceable

assemblies in our standard equipment including rolling stock would, in most cases, be inescapable. There should be simultaneous development of designs for new standard equipment based entirely on the metric system.

(Chapter IV, paras 4. 1. 3 & 4. 1. 5)

8. It would be futile to undertake any revision of designs and drawings of non-standard equipment, including non-standard rolling stock, which will not remain in service after 1970. Re-examination should, therefore, be confined mainly to the existing standard designs and drawings of equipment likely to remain is use beyond 1970. Such re-examination for the adoption of the new standards should be so carried out as to reduce the element of redesigning to a minimum and the leading dimensions of standard engineering equipment should, as far as possible, remain unaltered.

(Chapter IV, Para 4. 1. 5. 1)

9. Development of new designs of equipment should aim not only at the complete adoption of the newly developed metric standards but also result in such leading dimensions as will be convenient to trade and industry from the point of view of facility of manufacture and of its subsequent maintenance.

(Chapter IV, Para 4. 1. 5. 2)

10. The Central Standards Office should take immediate action in the matter of revision of standard designs and drawings, particularly those of standard locomotives to be manufactured in the immediate future. Early availability of new designs for the existing standard equipment would reduce the transitional difficulties in respect of new equipment and may also reduce the period of the complete changeover.

(Chapter IV, paras 4. 2. 2. 1 & 4. 7. 8)

11. The Central Standards Office should immediately select suitable metric scales for use in Engineering Drawing Offices and issue a directive to all Railways on this subject.

(Chapter IV, para 4. 2. 3. 1.)

12. In order to eliminate duplication of tracing work at various centres, adequate arrangements for additional printing room equipment should be made by the Central Standards Office for the preparation and distribution to Railways of sets of mechanical tracings and ferros of revised drawings.

(Chapter IV, Para 4. 2. 3. 2)

13. Necessary additional office accommodation for the Central Standards Office should be arranged on a priority basis.

(Chapter IV, Para 4. 10)

14. Provision of roving Instructors of the rank of Inspectors or Assistant Inspectors would be necessary on all zonal Railways for training the Class IV and artisan staff distributed all over the line.

(Chapter V, para 5. 2. 1. 1)
(Chapter VI, para 6. 4. 9)
(Chapter VIII, para 8. 5)
(Chapter IX, para 9. 5 etc)

15. Engineering works which are likely to commence after 1960-61, should be planned entirely on the metric system. Designs of works in hand at present should show the leading dimensions also in the metric system.

(Chapter V, para 5. 2. 2. 1 & para 5. 2. 2. 2)

16. The Civil Engineering Department of Railways should work out the station-to-station distances in kilometres from the longitudinal sections, in advance of the actual fixation of kilometre posts and supply these particulars to the Commercial Department, not later than the end of 1957, to enable timely revision of fare and rate tables.

(Chapter V, para 5. 3)

17. Establishment of Planning Cells in the major Mechanical Workshops and Production Units would be necessary for assisting the local management.

(Chapter VI, para 6. 4. 1 & Chapter VIII, paras 7. 2. 2 & 7. 3. 2)

18. Railways should be advised immediately to commence marking of tare weight, carrying capacity, floor area on the existing and the metric units on all goods stock during periodical overhaul.

(Chapter VI, para 6. 6 'a')

19. Chittaranjan Locomotive Works should consider commencement of production of each metric assembly as and when its modified drawings are received from the Central Standards Office.

(Chapter VII, para 7. 2. 2. 7)

20. Production of integral design coaches to the metric standards at the Integral Coach Factory, Perambur, should commence with the 10th and 11th batches, sometimes in 1961-62.

(Chapter VII, para 7. 3.4)

21. All Production Units such as the Furnishing Unit at Perambur, Metre Gauge Integral Coach Factory, Duplicates Factory, etc. to be set up in future, should be planned on the metric basis and manufacture from the commencement of production should be based on the metric system only.

(Chapter VII, para 7.4)

22. Electrification projects likely to be taken in hand after 1960 should be planned on the metric basis.

(Chapter IX, para 9. 2)

23. Two Junior Scale Officers would be necessary for a period of 3 to 5 years, primarily for the revision of nomenclature lists in the Stores Branch of each zonal Railway.

(Chapter' X, para 10. 1. 3)

24. Existing organisations for the preparation of nomenclature lists should be suitably strengthened immediately so as to expedite the revision of these lists.

(Chapter X, para 10. 2. 1. 3)

25. The revision of bases for rates and fares and other charges in Commercial Branch of Railways may be carried out simultaneously for both decimal coinage and metric weights and measures and brought into effect on and from 1-4-60.

(Chapter XI, para 11. 2. 1. 4)

APPENDICES

APPENDIX I

APPOINTMENT OF RAILWAY METRIC COMMITTEE

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No. E55C01|39|3
New Delhi, Dated 20th August, 1955

To,

The General Managers,
Central, Eastern, Northern,
North Eastern, Southern, Western,
and South Eastern Railways.

The General Manager & Chief Engineer,
Ganga Bridge Project.

The Chief Administrative Officer,
Integral Coach Factory.

The Director Research,
Railway Testing & Research Centre,
Lucknow.

The Chief Design Engineer Incharge,
C. S. O.

Subject:—Appointment of an ad-hoc-committee to examine the question of changeover from the present system to metric system.

A note indicating briefly the action which has to be taken in connection with the introduction of the Metric System of weights and measures on Indian Railways is attached herewith.

2. The Board have decided to appoint an *ad hoc* committee consisting of the following members:—

(1) Shri S. L. Kumar, Director, Railway Testing & Research Centre .. *Chairman,*

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(2) Shri B. S. Sindhu, Chief Design Engineer, Incharge, C. S. O.

(3) Shri V. Venkataramayya, Chief Design Engineer, (Civil).

(4) Shri L. C. Mohindra, Chief Design Engineer, (Signals).

(5) The Railway Liaison Officer .. ...

} *Members.*

(6) Shri K. V. Kasturi Rangan, Joint Director, Finance (E)	Members
(7) Shri R. E. de Sa, Joint Director, Civil Engineering.	
(8) Shri L. T. Madnani, Joint Director, Mechanical Engineering.	
(9) Shri G. D. Khandelwal, Joint Director, (Traffic Transportation).	
(10) Shri D. R. Suri, Joint Director, Traffic (General).	
(11) Shri D. S. Mehta, Deputy Director, Tele-Communication.	

The Chairman of the Committee may co-opt additional members, if so desired, under advice to the Railway Board.

3. The Committee will advise the Board on :—

(a) How the changeover from the present system to the metric system should be effected.

(b) Phasing of the changeover.

(c) Financial Implications.

4. The Committee will submit its report to the Railway Board in about 3 months. The Officers will perform the work of the Committee in addition to the normal duties and will draw Travelling Allowance according to their rules.

(Sd.)
Joint Director, Establishment,
Railway Board.

D. A. As above. (Not attached).

APPENDIX II.

NOTE AND QUESTIONNAIRE ISSUED TO RAILWAYS.

Note : It is proposed to give in this note a brief outline of the quantum of work entailed in the introduction of metric system in each branch of the Railway. A little consideration will show that the Mechanical Branch on the railways will be the one most affected by the changeover. It will, therefore, take the longest time in finally adopting the new system and in abandoning the existing one.

Mechanical Engineering Branch.

From the point of view of the changeover, the work in the Mechanical Engg. Branch may be divided into the following categories :—

(a) In the design and drawing sections.

(b) In the production sections of the Workshops.

(c) In the maintenance section of Workshops & Sheds.

(d) In the Railway Manufacturing Workshops i. e., Chittaranjan Locomotive Works and Integral Coach Factory, Perambur.

In the Drawing & Design Sections, the changeover would involve a colossal task. A rough idea of this can be obtained when it is borne in mind that there are an present about 250 types of locomotives in use in India, each having at least 400 assembly and 'subassembly drawings and 5,000 part and component drawings. Similarly, the designs of coaches and wagons are legion. In order to make the work manageable, it is proposed that no change should be made in the drawings of those locomotives or rolling stock which are likely to finish their useful life during the next 10 to 15 years. A rough estimate shows that at the end of this period, there will be only about 50 types of locomotives in use and about a similar number of types of coaching and goods stock. In the drawings of the recent types, therefore, it would be essential to indicate the alternative dimensions in mms. in brackets. It might sometimes to necessary to redraw some of them and indicate the dimensions in the metric system only. A large number of draftsmen will be required for this work and the railways have been asked to make their own arrangements for the training of draftsmen and tracers. Unfortunately, this category of staff is in short supply all over India in all the Engineering Departments. It is understood, that the Ministry of Education has also directed the Technical Schools and Colleges to start condensed courses for the training of draftsmen. The existing staff working in the drawing offices will have to be given intensive training with a view to familiarizing them with the new units. As the metric system is easier for learning and for calculations, the changeover should not involve any great difficulty. For easy reference, conversion tables and charts should be printed and supplied to each draftsman.

The work in the production sections in workshops will be equally onerous. The production staff will be continuously faced with the necesisty of taking rapid decisions as to which of the designs of spares and components should be modified to conform to the new system and which spares and components can continue to be manufactured according to the existing designs. At a subsequent stage, when rolled sections to the new system which are at present under the consideration of the Indian Standards Institution, become available from the new steel mills, a production engineer will have to solve the problem of mating the new sections to the existing sections. This will in many cases entail a good deal of design and drawing work.

The Indian Standards Institution are going to issue a Code giving fits and tolerances suited to the Metric System and the production staff will have to decide, in consultation with the machine staff, which fits and tolerances are to be applied for manufacture of any component or part. The problem will, therefore, have its complexities, though by no means will it be insurmountable.

In the machine shops in most cases, the changeover will not entail any large outlay on purchase of new equipment. The existing machines can continue to fabricate spares and component parts to designs on the existing system as well as on the metric system, as is being done in manufacturing countries like Japan, U. K., Germany etc. Only two sets of gauges, measuring devices, lead screws and setting gears will be required. Besides these, certain auxilliary equipment like jigs, fixtures and small tools like drills, reamers, taps and dies to suit the new system will have to be stocked. As the existing machines and tools come to the end of their useful life, the replacement henceforward will be made by machines and tools designed and calibrated to the new system. The financial strain or additional expenditure in such a gradual changeover should not, therefore, be heavy. If the period of co-existence of the two systems is extended over about 15 years, it is probable that none of the existing machines will have to be scrapped. The purchase of new machines and tools from abroad will not create any difficulty or problem as even countries like the U. K. and U. S. A. will readily supply machines to suit the new system.

The training of personnel to become conversant with the new system should start at once. All apprentices who are getting training over periods of three to five years, should receive intensive training so as to get familiar with the metric system. Refresher courses for staff in Workshops and for operatives should soon be started. The operatives, being in most cases semiliterate, would require individual attention during the period of training. An immediate disadvantage of the changeover may be a slight fall in the efficiency and in the production norms till all the technical personnel and operatives have acquired enough knowledge and sound conception of the new system.

The introduction of the metric system is not likely to cause any complication in the Locomotive Workshop at Chittaranjan. Most of the machines would not require any change whatsoever. Assuming that the machinery there has an approximate life of 20 years, by the time the changeover is completed, say by 1970, most of the machines would have come to the end of their useful life. Though the changeover in the Workshop may not be difficult, the question of repercussions of the changeover on the ancillary industries and or the producers of rawmaterials has to be considered carefully. It would also involve resetting or replacement of the machine tools in use including scales, gauges, micrometers etc. It is roughly estimated that the changeover would cost about Rs. five lakhs.

The Integral Coach Factory has just gone into production. The majority of the machines were purchased from the Continent where the metric system is in use, though before supply they had to be altered from the metric to the inch system. On the introduction of the metric system, verniers, scales and lead screws of machines can easily be changed. The manufacturers of various other machines which are yet to be supplied could be told that the machines should hence forward be designed and calibrated to the metric units.

Civil Engineering Branch.

In the Civil Engineering Branch, this problem has to be considered in its following four aspects :—

(a) Preparation of new projects and detailed designs of structures.

(b) Execution of projects and organisation of construction in the field.

(c) Buying materials, modifying specifications and adopting at site of materials manufactured to both old and new specifications and sizes.

(d) Training of artisans and workmen to familiarise them with the new system.

Besides the above, it would be necessary to substitute mile pillars along the railway lines by kilometre posts. Number plates on the telegraph posts will also be similarly changed from the mile to the kilometre unit. Basic records such as bridge registers, bridge lists, track diagrams etc. based at present on the mile unit will have to be modified to tally with the new distance marks.

Assuming that the Parliament passes the law relating to the adoption of the metric system by 1956, the preparation of new projects which are likely to be completed by 1960 and also preparation of detailed designs of structures relating thereto may be made in the existing units, but basic dimensions in project reports, documents and important drawings should be indicated in brackets in the metric units also. The reason is that during the execution of these projects, raw materials such as rolled section, rivets, bolts and nuts required for the construction work will be available according to the existing standard sections. Towards the close of the first pentennial, rolled sections designed to the metric units may be available from the Indian Steel mills. At that stage, it would be necessary to modify the standard designs to suit the new units, revised specifications and new standard sizes. All projects the execution of which is not likely to start before 1958, should be prepared exclusively in terms of the metric units.

In the Drawing & Design Offices, the immediate change would be the introduction of a second set of scales graduated to the metric units. The existing standard plans can continue to be used. It may be necessary to redimension some of them to the metric units.

At the site of construction, the impact of the changeover will hardly be felt. The tapes and scales, such as the mason's triangle, the carpenter's rule and the blacksmith's scale will have to be replaced by scales in the new units. The workmen will have to be trained to get familiar with their use.

In the manufacture and supply of materials, the changeover may be gradual and hardly perceptible. It will only affect the machine-made materials to the extent to which the new specifications for weights, packing sizes and moulds, etc., call for these changes.

Signalling, Tele—Communication and Electrical Engineering Branches.

The nature & extent of the changeover will be similar to those described above for the Mechanical and Civil Engineering Branches. Most of the equipment for the Electrical Engineering is already working on the metric units. Only certain gauges, tools and instruments will need replacement or, in some cases, recalibration only.

In all the Engineering branches, the first pentennial may be treated as a preparatory period. In it the following tasks should be given the highest priority :—

(a) Preparation of Design Manuals, Reference Books to suit the new system for the guidance of the staff.

(b) Training of operatives, skilled and unskilled workmen and artisans in the use of the new units.

(c) Revision of the material specifications so as to conform to the new units and of the Schedules of Rates based on these specifications. It may be assumed that the basic output of each operative or artisan will remain the same as at present. A little loss of efficiency or of the output with the adoption of the new units may be reflected in the slightly higher rates quoted by contractors. This will, if at all noticeable, be a passing phase.

(d) Re-dimensioning of the standard drawings to show millimetre dimensions in brackets.

Traffic & Commercial Branches.

The Traffic Branch will be the least affected by the changeover. It will have to issue revised time and fare tables based on the kilometre as the unit of distance and in terms of the decimalised currency. For sometime, the distances between stations may have to be shown both in miles and kilometres. Working Rules at stations will have to be modified so as to show distances and locations in terms of the new distance marks.

In the Commercial Branch, the changeover would entail a good deal of laborious calculations before it can issue the three Tariffs (General, Goods and Coaching). This work can be started only after the recommendations of the ad hoc Freight Structure Revision Committee, now busy with its work, have been accepted by the Parliament.

The mileage tables would have to be converted into tables based on the kilometre units and the printing of tickets showing the distances in kilometres only and fares in the decimalised currency would be necessary.

Weighing machines both of the beam scale type and of the dial type would have to be recalibrated to show weights in kilograms. This calibration could be entrusted to a firm who manufacture these weighing machines or may be carried out in a Railway workshop. To expedite the recalibration work, it may be necessary for each railway to purchase a certain number of new machines of both types showing the weights both in kilograms and maunds & seers. These should replace an equal number of existing machines which can be sent for recalibration. Thus all the existing weighing machines can be recalibrated in eight to ten instalments over a period of three to five years.

On an appointed date all the invoices, waybills, etc., will be drawn up to show the weights in kilograms only. For the facility of merchants and the Railway staff, conversion tables can be hung up in Goods Sheds and parcel Offices showing the equivalents of kilograms in maunds & seers. Before the changeover can, however, be effected, it will be necessary to give adequate training to the Commercial staff, such as booking, goods and parcel clerks.

Stores Branch.

Besides the training of the staff and the revision of Manuals, Codes and Specifications to conform to the new units, the work involved will not be much. Extra storage accommodation for stacking separately of parts and spares built to the existing and to the new systems will have to be provided. This may also involve some additional clerical work for accountal of these items. As the Stores Branch has to depend upon the trade for Supply of its raw materials, its task would become very much easier if the industry did not lag behind in the adoption of the new units.

On an appointed date, the existing stock registers and ledgers, which are at present being maintained to the foot-pound system, should be closed and all the balances should be brought forward on new registers and ledgers printed to conform to the new units, so that at no stage will it be necessary to show the balances in both the units. At this stage, the weighing machines calibrated to the new units should also be available at all the Stores Depots. Simultaneously, tenders and quotations should be called based only on the new system of weights and measures and as in most commodities the buyers, market is ruling at present, traders would willingly submit their quotations according to the Railways' revised requirements.

The conversion of stocks on a specified day from one set of units to the other should not involve any shortages or discrepancies; at any rate, they would not be any more than those now generally found to exist between the ledger and ground balances under the existing system.

Sd/-- S. L. Kumar.
3. 11. 55.
CHAIRMAN
RAILWAY METRIC COMMITTEE.

Appendix II (continued)

QUESTIONNAIRE.

Civil Engineering Branch.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement category wise.

1. Assuming that the changeover from the existing system of weights and measures to the Metric System will be gradual, will any special machinery be needed to implement the changeover ?

2. In which sphere of the activity of your branch will it be necessary for the two systems to coexist and in which sphere or operation will a sudden changeover be desirable ? Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Give an estimate of the work and expense involved in—

   (a) fixing kilometre pillars. The existing mileposts will be allowed to remain for sometime.

   (b) fixing of number-plates on the telegraph posts in relation to the new kilometre posts.

   (c) revision of description boards, capacity figures ofwater tanks, bench marks, description plates to give tl ndications in the metric units.

5. How do you propose to phase the work of providing particulars regarding lengths, distances, locations, areas and volumes in metric units in connection with the following basic records :—

   (a) Bridge Registers and other records.

   (b) Yard plans and other station working plans.

   (c) Index plans and sections.

   (d) Land plans.

   (e) Type plans.

   (f) Completion and record plans.

   (g) Standard measurements books.

6. Indicate the amount of work involved in the changeover in modifying, retracing and/or redimensioning the existing standard drawings and drawings of structures. From what date should the new projects including surveys and constructions, be prepared in terms of metric units ?

7. How far the equipment and machines in bridge and structural workshops—

   (a) will have to be completely scrapped in going over to the metric system ?

   (b) can be allowed to work to the existing system till their useful life is finished ?

   (c) can be adapted with minor changes to work on both the systems ?

   N. B. The answers should be divided under the following categories :—

   (i) Machines.

   (ii) Machine tools.

   (iii) Small tools, appliances and measuring instruments.

   (iv) Jigs and fixtures.

8. Will it be possible to modify indents for equipment, machines and tools already placed so as to obtain them designed and/or calibrated to the metric system ? How far will the possible resulting delay in their supply affect your work ? If it is not proposed to make any change in the indents, please give your reasons.

9. Indicate the extent of work involved in the revision of manuals, codes, specifications, schedules of rates, contract documents and rule books, so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

QUESTIONNAIRE.

Mechanical Engineering Branch.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Assuming that the changeover from the existing system of weights and measures to the Metric System will be gradual, will any special machinery be needed to implement the changeover ?

2. In which sphere of the activity of your branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desirable ? Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Indicate the amount of work involved in the changeover in modifying, retracing and|or redimensioning the existing drawings which may be divided under the following main heads:—

(a) Locomotives—Gaugewise.

Assembly, sub-assembly and part drawings for—

(i) pre—BESA locomotives.

(ii) BESA locomotives.

(iii) IRS type locomotives.

(iv) IR type locomotives.

(v) American type locomotives.

(vi) Electric locomotives.

(b) Coaches—Gaugewise.

All lay-outs, building sets and part drawings, separately for standard and non-standard stock, in respect of—

(i) Passenger stock.

(ii) Non-passenger stock.

(iii) EMU stock.*

*Non-standard here means pre—1951.

(c) Wagons—Gaugewise.
  (i) Non-standard stock.
  (ii) IRCA stock.
  (iii) IRS stock.

(d) Ferry stock.

(e) All miscellaneous drawings such as those for jigs, fixtures, tools , templates, etc.

5. How far the equipment and machines in Shops and Sheds—
(a) will have to be completely scrapped in going over to the metric system ?
(b) can be allowed to work to the existing system till their useful life is finished ?
(c) can be adopted with minor changes to work on both the systems.

N. B. The answers should be divided under the following categories :—

  (i) Machines.
  (ii) Machine tools.
  (iii) Small tools, appliances and measuring instruments.
  (iv) Jigs and fixtures.

6. Will it be possible to modify indents for equipment, machines and tools already placed so as to obtain them designed and|or calibrated to the metric system ? How far will the possible resulting delay in their supply affect your work ? If it is not proposed to make any change in the indents, please give your reasons.

7. Give your appreciation of the nature and extent of additional work involved in the drawing and production sections in the use of existing designs entailed by the changeover in regard to—
(a) Unprocessed materials such as foundry pig, blooms and billets.
(b) Semi-processed materials such as new rolled structural sections, plates, joists, angles, channels, etc.
(c) Finished materials such as bolts, nuts, studs, screws, etc.
N.B. Full appreciation of this work, however, will be possible only after the Indian Standards Institution publish the details of the metric sections to be adopted in India as also lay down standards of fits and tolerances for various categories of work.

8. Indicate the extent of work involved in the revision of manuals, codes, specifications and Instruction & Rule Books so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

QUESTIONNAIRE.

Signal & Interlocking Engineering Branch.

N.B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1, Assuming that the changeover from the existing system of weights and measures to the Metric System will be gradual, will any special machinery be needed to implement the changeover ?

2. In which sphere of the activity of your branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desirable ? Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affecated by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Indicate the quantum of work involved in the changeover in respect of drawings and plans in connection with—

   (a) redimensioning and retracing or redrawing and retracing of—

      (i) Indian Railway Standard Signals Drawings.

      (ii) Non-standard Signalling Equipment Drawiings.

      (iii) Signal Cabin Building Drawings.

   (b) showing adequate distances, lengths of loops and clear lengths of sidings of signalling yard plans in metric units.

5. How far the equipment and machines in the Signal Shops—

   (a) will have to be completely scrapped in going over to the metric system ?

   (b) can be allowed to work to the existing system till their full useful life is finished ?

   (c) can be adapted with minor changes to work to both the systems ?

N.B. The answers should be divided under the following categories:—

(i) Machines.

(ii) Machine tools.

(iii) Small tools, appliances and measuring instruments.

(iv) Jigs and fixtures.

6. Do you visualise any problems or difficulties in the manufacture of signalling equipment designed to metric units in your Signal Workshops ? If so, give details of the problems that would need attention with your proposals, if any.

7. Will it be possible to modify indents for equipment, machines and tools already placed so as to obtain them designed and|or calibrated to the metric system ? How far will the possible resulting delay in their supply affect your work ? If it is not proposed to make any change in the indents, please give your reasons.

8. Indicate the extent of work involved in the revision of manuals, codes and specifications so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

9. Give your appreciation of the difficulties in the coversion of the existing designs of Signalling equipment into metric units keeping in view the availability of raw materials, rolled sections, revised fits and tolerances and interchangeability of the mating parts designed to the existing and metric systems.

QUESTIONNAIRE.

Electrical and Telecommunication Engineering Branches.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Assuming that the changeover from the existing system of weights and measures to the Metric System will be gradual, will any special machinery be needed to implement the changeover ?

2. In which sphere of the activity of your branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desirable ? Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4, Indicate the amount of work involved in the changeover in modifying, retracing and | or redimensioning the existing part and assembly drawings.

5. How far the equipment and machines in the Electrical Shops & Depots—

   (a) will have to be completely scrapped in going over to the metric system ?

   (b) can be allowed to work to the existing system till their useful life is finished ?

   (c) can be adapted with minor changes to work on both the systems ?

N. B. The answers should be divided under the following categories :—

(i) Machines.

(ii) Machine tools.

(iii) Small tools, appliances and measuring instruments.

(iv) Jigs and fixtures.

6. Will it be possible to modify indents for equipment, machines and tools already placed so as to obtain them designed and/or calibrated to the metric system ? How far will the possible resulting delay in their supply affect your work ? If it is not proposed to make any change in the indents, please give your reasons.

7. Indicate the extent of work involved in the revision of manuals, codes and specifications so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

8. Give an appreciation of the difficulties and additional work involved in the use of new standard rolled sections, bare and insulated cables and other materials designed to the metric units with special reference to the manufacture and repair of the electrical or electronic machines and their components and spare parts.

N. B. Full appreciation of this work, however, will be possible only after the Indian Standards Institution publish the details of the standard rolled sections and specifications of materials adapted to the metric system.

Appendix II (continued)

QUESTIONNAIRE.

Stores Branch.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Assuming that the changeover from the existing system of weights and measures to the metric system will be gradual, will any special machinery be needed to implement the changeover ?

2. In which spheres of activity of your Branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desireable ? Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of the training to be given to the Depot & Inspection staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Do you agree that in the preparatory stage, which may extend over five years, all accountal of stores should be in the existing system and on a prescribed date thereafter the accountal and issue of all stores should be made in the metric system ? What problems, if any, are likely to be created by adopting this system and how do you propose to overcome them ?

5. In relation to the changeover of accountal envisaged in Question 4 above, at what stage would you recommend calling of quotations and tenders for supplies in the metric units ?

6. Will there be any difficulties if all future indents of equipment and machinery are placed so that the new equipment or machines are designed and|or calibrated to the metric system ? Do you anticipate any difficulties in locating manufacturers for supplying equipment and machinery to the metric system ?

7. What additional accommodation would be required for stocking the following material designed to the metric system, while supplies are concurrently being made of materials to the foot-pound system also :—

   (a) Unprocessed materials, such as foundry pig, blooms and billets.

(b) Semi-processed materials, such as new rolled structural sections, plates, joists, angles, channels, etc.

(c) Finished materials, such as bolts, nuts, studs, screws, taps and dies.

8. Give an appreciation of the additional clerical work involved in accountal and issue of the materials designed to the metric system concurrently with the material designed to the existing system.

9. Indicate the extent of work involved in the revision of manuals, codes, price lists and instruction & rule books so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

10. Give an appreciation of the work involved in getting all existing forms and items of stationery, ledgers, account books, tender notices and contract documents revised and reprinted so as to conform to the metric units.

QUESTIONNAIRE.

Traffic & Commercial Branches.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Assuming that the changeover from the existing system of weights and measures to the Metric System will be gradual, will any special machinery be needed to implement the changeover.

2. In which spheres of activity of your Branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desirable. Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Assuming the unit of weight to be a kilogram and unit of distance a kilometre, state up to how many places of decimal should we show the present maxima and minima of rates and fares and other basic charges for different varieties of traffics.

N. B. The unit of money will be a rupee divided into 100 cents.

5. What should be the procedure for replacement of the existing methods of rounding off—

   (i) fractions of units of weights and distances.

   (ii) fractions of rupee.

6. (a) Please indicate the work, time and expense involved in recalibrating the existing weighing machines and weigh-bridges to the metric units.

   (b) If recalibration is not possible, indicate reasons why it is not so. What is the residual life yet left in these machines ?

   (c) Give an estimate of the cost of replacement of all weighing machines, weights and measures which cannot be continued in use or recalibrated. Can this work be phased ? If so, how ?

7. Please indicate the time, work and expense involved in :—

(a) revision of existing tariffs, e. g., in respect of the minimum distance for charge, the minimum weight for charge, the minimum weight for carriage by goods trains, the minimum charge, the rates for terminals, transhipment and short-distance charges, etc.

(b) expression of existing bases of rates and fares in decimalised currency and according to metric units of weights and distances.

(c) revision of Goods and Parcels Rate Tables, Time-Tables & Guides, Fare lists, etc.

(d) revision of junction mileage tables of your railway showing distance of each station on your system via each junction and the local mileage tables showing the distances between stations locally on your railway in kilometres.

(e) modifications to ticket printing machines to show distances between stations in kilometres and fares in decimalised currency.

N. B. In case of 3rd class tickets, this information will be given in local vernaculars also. Will the existing machines for printing tickets require any modifications ?

(f) revision of station working rules.

8. Indicate the extent of work involved in the revision of manuals, codes and reference books so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete work ?

QUESTIONNAIRE.

Medical Branch.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. State in detail if it will be necessary—

   (a) to replace any equipment.

   (b) to recalibrate any equipment on the introduction of the metric system.

2. Indicate whether it will be necessary to give any training to the staff to acquaint them with the new system. If so, what arrangements do you propose for giving the training ?

3. Give your appreciation for the quantum of work involved in revision of books of reference, registers, forms, etc.

QUESTIONNAIRE.

Integral Coach Factory
and
Chittaranjan Locomotive Works.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Assuming that the changeover from the existing system of weights and measures to the metric system will be gradual, will any special machinery be needed to implement the changeover.

2. In which spheres of activity of your branch will it be necessary for the two systems to co-exist and in which sphere or operation will a sudden changeover be desirable. Please give details of the phasing of the changeover with reasons therefor.

3. Indicate the nature and extent of training to be given to different categories of staff affected by the changeover and estimate the cost of such training. What arrangements do you propose for giving this training ?

4. Indicate the amount of work involved in the changeover in modifying, retracing and|or redimensioning the existing locomotives|coaches, assemblies, sub-assemblies, parts and components, indicating also how the work will be phased.

5. How far the equipment and machines in Shops—

   (a) will have to be completely scrapped in going over to the metric system ?

   (b) can be allowed to work to the existing system till their useful life is finished ?

   (c) can be adapted with minor changes to work on both the systems ?

   N. B. The answers should be divided under the following categories :—

   (i) Machines.
   (ii) Machine tools.
   (iii) Small tools, appliances and measuring instruments.
   (iv) Jigs and fixtures.

6. Will it be possible to modify indents for equipment, machines and tools already placed so as to obtain them designed and/or calibrated to the metric system ? How far will the possible resulting delay in their supply affect your work ? If it is not proposed to make any change in the indents, please give your reasons.

7. Give your appreciation of the nature and extent of additional work involved in the drawing and production sections in the use of existing designs entailed by the changeover in regard to

   (a) Unprocessed materials such as foundry pig, blooms and billets.

   (b) Semi-processed materials such as new rolled structural sections, plates, joists, angles, channels etc.

   (c) Finished materials such as bolts, nuts, studs, screws, etc.

   N. B. Full appreciation of this work, however, will be possible only after the Indian Standards Institution publish the details of the metric sections to be adopted in India as also lay down standards of fits and tolerances for various categories of work.

QUESTIONNAIRE.

Central Standards Office.

N. B. While answering questions please indicate in detail the financial implications of the proposals made and the additional staff requirement categorywise.

1. Indicate the nature and extent of training to be given to the technical staff employed to familiarize them with the use of metric units. Will any special arrangements be necessary for giving this training ?

2. Indicate the amount of work involved in modifying, retracing and/or redimensioning the existing standard designs concerning the following :—

   (a) Locomotives.

   (b) Coaches.

   (c) Wagons.

   (d) Bridges and structures.

   (e) Track assemblies.

   (f) Signalling & Electrical Devices.

   (g) Architectural plans.

   Indicate how the above work will be phased and what extra staff will be required ?

3. Indicate the extent of work involved in the revision of manuals, codes, specifications, general rules, maximum-minimum dimensions, etc. so as to adapt them to the metric units. What arrangements do you propose and how long will it take to complete this work ?

APPENDIX III.

POLICY REGARDING FUTURE INDENTS OF MACHINERY AND PLANT.

Copy of letter No. 55|964|2|M dated 28. 5. 56, from the Railway Board, New Delhi, to the General Managers, All Indian Railways, and others.

Sub:—Introduction of Metric System of weights and measures on Indian Railways—Application to Machine Tools & Plant.

The Board have accepted in principle, the introduction of the Metric System on the Indian Railways. In order to ensure that the introduction of this system will not result in hold up of production in the transition stage when both the Inch System and the Metric system are likely to be in use, which stage may extend over a number of years, the following action may be taken in respect of Machines and Tools and Plant to be indented for hereafter:—

(a) general-purpose machines where measurement is by scales affixed such as planers, shapers, slotters, etc. should be indented with the Inch scales as well as Metric Scales ; and

(b) machines required for screw cutting and gear cutting work should be indented with duplicate equipment suitable for Inch system and for Metric System.

2. While placing indents in regard to items of equipment under (b) above the indentors should decide whether two sets of gears etc., one to the Inch system and the other to the Metric system, or only one set should be indented, depending upon the requirements the machine has to fulfil.

3. In regard to machine tools and other equipment already indented, the indentor may review the position and decide whether duplicate equipment for the Inch and Metric systems should be indented now, particularly for screw cutting and gear cutting work. The points to be considered here will be that there is no interference with producation and maintenance work and there are no financial complications with the suppliers in respect of the machines and tools already ordered. If the suppliers, in this connection, quote excessive prices for the supply of duplicate equipment in these cases, the Railways may re-examine the position and, if possible, do not ask for such duplicate equipment in these cases.

Copy of letter No. 55|954|2|M dated 28. 7. 56. from the Railway Board, New Delhi, to the General Managers, All Indian Railways, and others.

Sub:—(Same as above)

Ref:—Railway Board's Circular letter No. 55|964|2|M dated 28. 5. 56.

In continuation of Board's above quoted letter, it may be noted that the instructions contained therein apply in principle to machinery, tools and plant etc. required for all departments|branches of Railways which have to purchase new machinery and equipment. It is also requested that the phrase "F.P.S. System" be substituted instead of "Inch System" whereever used in the above-mentioned letter. In the case of the electrical equipment however, where it is already according to the metric units, no change in theexisting policy is intended.

APPENDIX IV.

PLACES VISITED BY THE RAILWAY METRIC SUB-COMMITTEE AND OFFICIALS INTERVIEWED.

Places Visited	Date of Visit	Officials Interviewed.
Delhi	26. 10. 56	Representatives of the Northern Railway.
Bombay	5. 11. 56 to 7. 11. 56	Representatives of the Western and Central Railways.
Madras	9. 11. 56 to 12. 11. 56	Representatives of the Southern Railway and the Integral Coach Factory.
Delhi	14. 11. 56	Representatives of the Central Standards Office.
Calcutta	19. 11. 56 to 21. 11. 56	Representatives of the Eastern and South Eastern Railways.
Chittaranjan	22. 11. 56	Representatives of the Chittaranjan Locomotive Works.
Gorakhpur.	29. 11. 56 to 30. 11. 56	Representatives of the North Eastern Railway.

APPENDIX V.

PARTICULARS OF COMMITTEE MEETINGS.

Serial No.	Date	Place	Particulars
1.	15. 9. 55	New Delhi	Committee Meeting
2.	17. 9. 56	New Delhi	—do—
3.	11. 10. 56	New Delhi	Sub- Committee Meeting.
4.	17. 10. 56	New Delhi	—do—
5.	19. 10. 56	New Delhi	—do—
6.	25. 10. 56	New Delhi	—do—
7.	1. 12. 56	Lucknow	Sub-Committee Meeting with Chairman.
8.	11. 12. 56	New Delhi	Drafting Sub-Committee Meeting.
9.	12. 12. 56	New Delhi	—do—
10.	13. 12. 56	New Delhi	—do—
11.	14. 12. 56	New Delhi	—do—
12.	19. 12. 56	New Delhi	—do—
13.	20. 12. 56	New Delhi	—do—
14.	21. 12. 56	New Delhi	—do—
15.	26. 12. 56	New Delhi	—do—
16.	27. 12. 56	New Delhi	—do—
17.	28. 12. 56	New Delhi	—do—
18.	29. 12. 56	New Delhi	—do—
19.	30. 12. 56	New Delhi	—do—
20.	31. 12. 56	New Delhi	—do—
21.	1. 1. 57	New Delhi	—do—
22.	14. 1. 57	New Delhi	—do—
23.	15. 1. 57	New Delhi	—do—
24.	16. 1. 57	New Delhi	—do—
25.	17. 1. 57	New Delhi	—do—
26.	18. 1. 57	New Delhi	—do—
27.	21. 1 57	New Delhi	—do—
28.	22. 1. 57	New Delhi	—do—
29.	23. 1. 57	New Delhi	—do—
30.	24. 1. 57	New Delhi	—do—
31.	4. 2. 57	New Delhi	—do—
32.	5. 2. 57	New Delhi	—do—
33.	6. 2. 57	New Delhi	—do—
34.	7. 2. 57	New Delhi	—do—
35.	8. 2. 57	New Delhi	—do—
36.	28. 2. 57	New Delhi	Committee Meeting

APPENDIX VI.

THE STANDARDS OF WEIGHTS AND MEASURES ACT, 1956.

No. 89 of 1956.

(28th December, 1956)

An act to establish standards of weights and measures based on the metric system

Be it enacted by Parliament in the Seventh Year of the Republic of India as follows:—

Short title, extent and commencement.

1. (1) This Act may be called the Standards of Weights and Measures Act, 1956.

(2) It extends to the whole of India except the State of Jammu and Kashmir.

(3) It shall come into force on such date, not being later than ten years from the passing of this Act, as the Central Government may, by notification in the Official Gazette, appoint; and different dates may be appointed for different provisions of this Act or for different areas or for different classes of undertakings or for different classes of goods.

Definitions.

2. In this Act, unless the context otherwise requires,

(a) "First General Conference of weights and Measures" means the Conference Generale des poids et Measures held at Paris in 1889.

(b) "International Bureau of Weights and Measures" means the Bureau Internationale des poids et Measures at Sevres in France ;

(c) "kilogram" means the mass of the platinum-iridium cylinder deposited at the International Bureau of Weights and Measures and declared international proto-type of the kilogramme by the First General Conference of Weights and Measures ;

(d) "metre" means the distance, at zero degree centigrade and under normal atmospheric pressure, between the axes of the two median lines traced on the platinum-iridium bar deposited at the International Bureau of Weights and Measures and declared international proto-type of the metre by the First General Conference of weights and Measures ;

(e) "normal atmospheric pressure" means the pressure exercised by 101325 newtons per square metre, a newton being the force which imparts to a mass of one kilogram an acceleration of one metre per second per second.

Primary Unit of Length.

3. (1) The primary unit of length shall be a metre.

(2) For the purpose of deriving the value of the metre, the Central Government shall cause to be prepared a national proto-type of the metre and shall cause the same to be certified in terms of the international proto-type of the metre and shall deposit the same in such custody and at such place as the Central Government may think fit.

Primary Unit of mass and standard Unit of weight.

4. (1) The primary unit of mass shall be a kilogram.

(2) For the purpose of deriving the value of kilogram, the Central Government shall cause to be prepared a national proto-type of the kilogram and shall cause the same to be certified in terms of the international proto-type of kilogramme and shall deposit the same in such custody and at such place as the Central Government may think fit.

(3) Not withstanding anything contained in sub-section (1) of this section and section 12, the primary unit of mass for precious stones shall be a carat which is equal to one-five-thousandth of one kilogram.

(4) The standard unit of weight at any place shall be the weight of the primary unit of mass at that place.

Unit of time.

5. (1) The primary unit of time shall be a second.

(2) A second means 1|31,556,925.975 of the length of the tropical year for 1900.0, the year commencing at 12.00 hours universal time on the 1st day of January, 1900.

Unit of electric current.

6. (1) The unit of electric current shall be an ampere.

(2) An ampere means that constant current which, flowing in two parallel straight conductors of infinite length, of negligible circular cross section and placed at a distance of one metre from each other in vacuum, produced a force of 2×10^{-7} newtons per metre length between the conductors.

Scale of Temperature.

7. The Scale of temperature shall be the centigrade scale otherwise known as celsius where the temperature, under normal atmospheric pressure, is taken to be zero degree at the melting point of ice and one hundred degree at the boiling point of water.

Unit of luminous intensity.

8. (1) The unit of luminous intensity shall be the candela.

(2) A candela means one-sixtieth part of luminous intensity normally emitted by one centimetre square of integral radiator (black body) at the temperature of solidification of platinum.

Primary Unit of area.

9. The primary unit of area shall be the square metre.

Primary Unit of volume.

10. The primary unit of volume shall be the cubic metre.

Unit of capacity.

11. The unit of capacity shall be a litre which is the volume occupied by the mass of one kilogram of pure air-free water at the temperature of its maximum density and under normal atmospheric pressure.

18. (1) The Measures of Length Act, 1889, and the Standards of Weight Act, 1939, are hereby repealed.

Repeal

(2) The enactments specified in the Second Schedule shall, to the extent to which they contain any provision which corresponds to any provision of this Act, stand repealed.

(3) If, immediately before the commencement of this Act or any provision thereof in respect of any area or class of goods or undertakings, there is in force in respect of that area or class of goods or undertakings, any law which corresponds to this Act or to any provision thereof and which is not repealed by sub-section (1) or sub-section (2), that corresponding law shall stand repealed.

APPENDIX VI (continued)

THE FIRST SCHEDULE

(See Section 16 (1))

STANDARDS OF WEIGHT

1	grain	=	0·000064799	kilogram
1	ounce	=	0·0283495	kilogram
1.	pound	=	0·4535924	kilogram
1.	cwt.	=	50·802	kilograms
1.	ton	=	1016·05	kilograms
1.	tola	=	0·0116638	kilogram
1.	seer	=	0·93310	kilogram
1.	maund	=	37·3242	kilograms

STANDARDS OF LENGTH AND CAPACITY

1.	inch	=	0·0254	metre	(exact)
1.	foot	=	0·3048	metre	(exact)
1.	yard	=	0·9144	metre	(exact)
1.	mile	=	1609·344	meteres	(exact)
1.	imperial gallon	=	4·54596	litres	

APPENDIX VI (concluded)

THE SECOND SCHEDULE

(See Section 18 (2))

1. The Assam Adoption of Standard Weights Act, 1955, (IX of 1955).
2. The Bhopal State Weights and Measures Act, 1953, (XV of 1953).
3. The Bihar Weights Act, 1947, (XVII of 1947).
4. The Bombay Weights and Measures Act, 1932, (XV of 1932).
5. The Central Provinces and Berar Weights and Measures of Capacity Act, 1928, (II of 1928).
6. The Cochin Weights and Measures Act, 1112, (LXIII of 1112).
7. The Coorg Act, 1954 (VII of 1954).
8. The Hyderabad Weights and Measures Act, (XIV of 1356 Fasli).
9. The Madhya Bharat Weights Act, 1954, (21 of 1954).
10. The Madras Weights and Measures Act, 1948, (XXII of 1948), as in force in the State of Madras or of Andhra.
11. The Mysore Weights and Measures Act, 1902 (III of 1902).
12. The Orissa Weights and Measures Act, 1943, (VII of 1943).
13. The Punjab Weights and Measures Act, 1941, (XII of 1941).
14. The Rajasthan Weights and Measures Act, 1954, (XIX of 1954).
15. The Travancore Weights and Measures Act, 1085, (VI of 1085).
16. The United Provinces Weights and Measures Act, 1947, (XX III of 1948).

APPENDIX VII

NOTE ON METRIC SCREW THREADS*

1. The International Organisation for Standardisation (ISO) has been attempting for some years, to evolve an international system of screw threads with a view to combining the inch-based system and the Systeme-International (metric threads in use on the Continent). The following agreements have so far been reached.

(a) The ISO Thread Profile almost identical with the Unified Thread Profile (evolved during the War by the ABC countries-America, Britain and Canada from defence considerations) which for all practical purposes is the same as the Systeme International (S. I.)

(b) Pitch-diameter series below 6 mm diameter—This has been incorporated in Draft ISO Recommendation No. 84 and corresponds very nearly to the coarse series below 6 mm of S. I. It has been estimated that this range represents about 80% of the total world production in number of screwed fasteners. For series above 6 mm diameter, agreement has not yet been possible between the inch and metric countries, but attempts are being pursued in the case of finer pitches where a compromise may be possible mostly on the basis of Systeme International. In the case of coarse pitches for series above 6 mm diameter, it has been found necessary to allow the existing practices to continue at present.

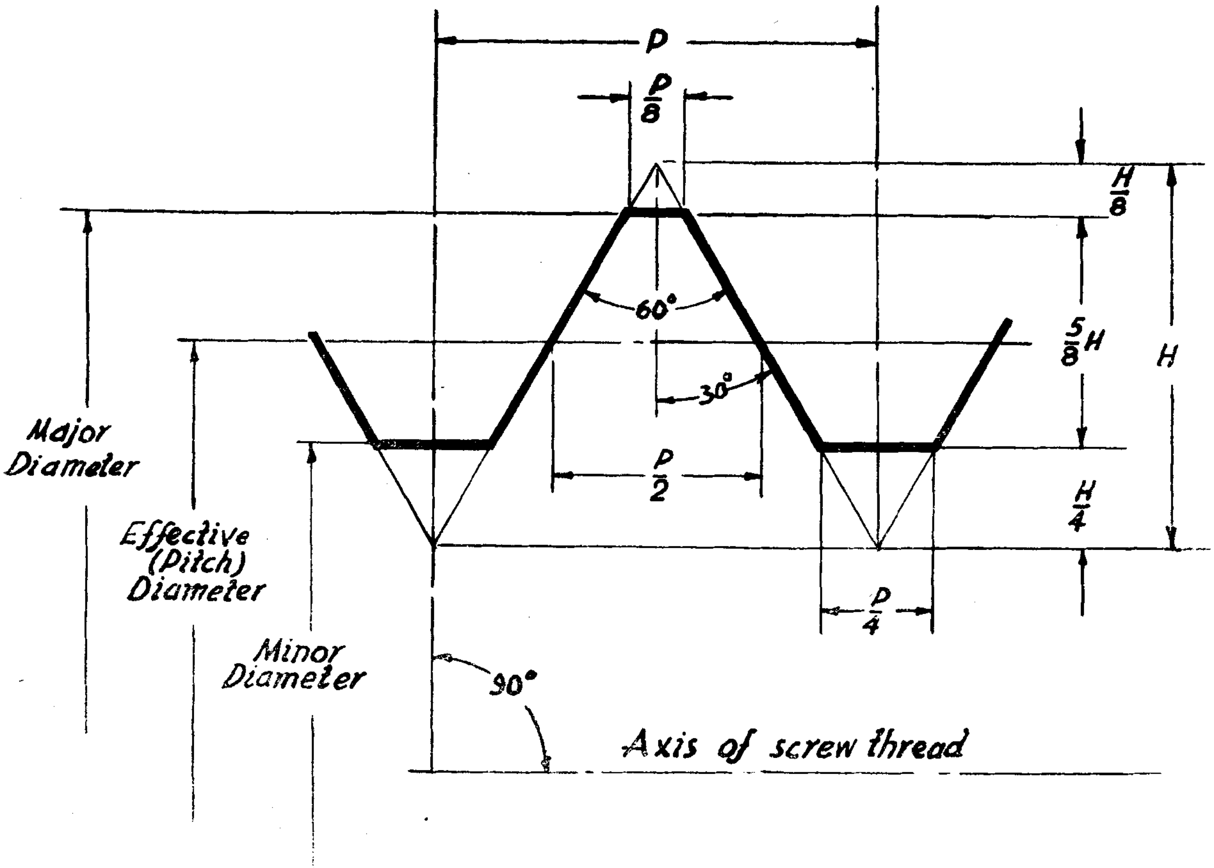
2. ISO Thread Profile :

The basic profile of the ISO triangular thread is shown by the thick lines in the figure. In practice, clearance is provided at the major and minor diameters of mating threads. The thread angle is 60°.

3. The Indian Standards Institution has decided as follows :—

(a) To endorse Draft ISO Recommendation No. 84 dealing with series below 6 mm pitch diameter series and to adopt it straightaway as an Indian Standard. This IS: 886-1956 " Dimensions of Screw Threads below 6 mm " is under publication and gives the dimensions of screw threads, bolts, nuts having nominal major diameter of 0.25 mm to 5 mm for General purposes and special purposes. For General purposes the proposed pitch for 0.25 mm diameter is 0.075 mm and for 5 mm diameter is 0.8 mm while for special purposes it is 0.090 mm for 0.35 mm diameter and 0.750 mm for 4.5 mm diameter.

(b) For sizes 6 mm and above, the Systeme International series to be adopted as Indian Standard but with ISO profile. The profile of the S. I. differs from the ISO profile in the amount of truncation at the root. In view of the fact that the latter profile has been accepted by the ISO and ABC countries and since it has been adopted in India for screw threads below 6 mm, it has been decided to have the same profile for sizes 6 mm and above. Adoption of this profile for all the sizes in India would facilitate its application when the ISO brings out its recommendations on screw threads of nominal major diameters 6 mm and above. An Indian Standard



$H = 0{\cdot}86603\ P$

$\frac{H}{4} = 0{\cdot}21651\ P$

$\frac{H}{8} = 0{\cdot}10825\ P$

$\frac{5}{8}H = 0{\cdot}54127\ P$

Note *The Basic profile to which the deviations, which define the limits of the external and internal threads, are applied. Consequently it plays the same part in screw threads as the basic size does in the limits and fits applicable to plain holes and shafts.*

Triangular Screw Threads Basic Profile

for these sizes of screw threads is under preparation. The principal series of standard threads on S. I. system, which is proposed to be adopted in this Indian Standard, starts with a diameter of 6 mm associated with a pitch of 1. mm and a uniform pitch of 6 mm above 60 mm diameter. For sizes beyond 150 mm, the diameters progress in steps of 5 mm.

*(Extracted from ISI documents).